Mary L. D. Putnam

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EDWARD BORCHERDT, PR.

OFFICERS OF THE ACADEMY.

PREFACE

The tenth volume of the Proceedings of the Davenport Academy of Sciences was planned as a memorial to the former President, Mrs. Mary L. D. Putnam, to whose devotion and energy is due much of the present prosperity of the Academy, and who by her will established a permanent endowment for the publications of the Academy.

The papers in this volume were all written by scientific friends of Mrs. Putnam. One of them, Baron Charles Osten Sacken of Heidelberg, Germany, a life-long friend of the Academy, has recently died.

The volume was nearing completion a year ago when the sudden death of William Clement Putnam, and the bequest of his entire estate to the Academy, made it appropriate to include herein a sketch of his life with that of his mother. The preparation of this sketch has caused an unavoidable delay.

The design of a conventionalized butterfly on the cover was suggested by Mrs. Putnam's love and interest in the entomological work of her son, J. Duncan Putnam.

Beginning with Volume XI the Academy will issue the separate papers of its Proceedings as soon as printed.

THE PUBLICATION COMMITTEE.

AUGUST, 1907.

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MARY LOUISA DUNCAN PUTNAM

WILLIAM CLEMENT PUTNAM

MARY LOUISA DUNCAN PUTNAM.

A MEMOIR.

BY ELIZABETH DUNCAN PUTNAM.

MARY LOUISA DUNCAN was born on September 23rd, 1832, in Greencastle, Pennsylvania. She was the second child and eldest daughter of Joseph Duncan and Elizabeth Caldwell Smith. The family home was in Illinois, but Mr. Duncan was in Congress from 1826 to 1834. When the epidemic of cholera broke out in Washington in 1832 Mrs. Duncan sought refuge in Greencastle, where some Scotch cousins lived. Shortly after the birth of their daughter Mr. and Mrs. Duncan returned to Washington, D. C., their home for the next two years.

Both heredity and environment had a marked influence on the life of Mary Duncan. She was descended on both sides from Scotch and Huguenot ancestors.

Her father was the son of Major Joseph Duncan of Virginia, who in 1790 moved to Paris, Kentucky. The handsome stone house that he built still stands on the old square in Paris. Here his son Joseph was born in 1794. Major Duncan died in 1806, leaving a widow and six children. Joseph was the third son, but when he was twenty-one he was appointed guardian for his younger brothers. When the war of 1812 broke out he enlisted as an ensign. He was a man of great physical strength and bravery, and these qualities were often severely tested during the war. One time he was the bearer of dispatches to the Army of the Northwest and was obliged to go through the trackless forests, where he had many narrow escapes, as the Indians were friendly to the English. He aided in the defense of Fort Stephenson, at Lower Sandusky, now Fremont, Ohio, in 1813. Orders had previously come from General Harrison to Major Croghan, the commanding officer, to abandon the fort. A council of war was called,

and Duncan, as the youngest officer, was first asked to express his opinion. He answered decidedly in favor of defending the fort, "the order to the contrary notwithstanding." The majority were of like mind, and the small band of one hundred and forty men held the fort against several thousand British and Indians. The officers were court-martialed for disobeying orders, but were acquitted; and in 1834, Congress presented Major Croghan with a medal, and Duncan and the other officers with gold-mounted swords. The defeat of the British at this period had an important effect upon the war, preventing their occupancy of the southern shore of the lakes and reaching the supplies at Cleveland.

A few years after the war, Joseph Duncan retired from the army and settled in Illinois. He was soon made Major-General of Militia, and later became a member of the State Senate. While serving in the legislature he introduced and secured the passage, in 1824, of the first law establishing free public schools in Illinois. He was elected to Congress in 1826 as the sole representative from Illinois and remained in the House of Representatives until his election as Governor of Illinois in 1834. He then returned to make Jacksonville his home, building a large house after the model of his Kentucky home and naming it "Elm Grove." He served as Governor for the next four years and advocated many progressive measures, some of them in advance of his times.

The mother of Mary Duncan was Elizabeth Caldwell Smith, the youngest daughter of James R. Smith and Hannah Caldwell. Mr. Smith came to this country as a poor Scotch lad, and by his own exertions became a wealthy merchant in New York City. He married Hannah, the second daughter of the Rev. James Caldwell, who was one of the patriots of the Revolution. The Caldwells were a Huguenot family who fled from religious persecution in France to Scotland, and thence came to Virginia. James Caldwell was a graduate of Princeton College and in 1761 was ordained a Presbyterian minister. He embraced the cause of liberty with intense earnestness, preaching to the troops from the baggage wagons, and sometimes with pistols on his pulpit, so strong ran party feeling in New Jersey. He became a marked man to the British. His wife, a daughter of John Ogden, was shot by a British soldier as the troops marched through Connecticut Farms, New Jersey. She was sitting by her window, surrounded by nine

children and holding her baby in her arms. Shortly after this, Mr. Caldwell was shot by an American sentry who was supposed to be in the employ of the British. The nine orphan children were adopted by friends of the family, General Lafayette taking one of the boys back to France and educating him in his family.

It is easy to realize the earnestness and strong religious views of children with such a heritage. Hannah (Mrs. Smith) was a woman of great force of character. She died when her daughter, Elizabeth, was eighteen. The father having died some years previously, the home in New York was broken up and Elizabeth lived with her sister, Mrs. Matthew St. Clair Clark, in Washington, D. C. Mr. and Mrs. Clark were noted entertainers and in their home Miss Smith met all the most delightful society of Washington. It was at a dinner given by John Quincy Adams at the White House that Miss Smith met her future husband, Joseph Duncan. Henry Clay, who sat next her at dinner, spoke in the highest terms of young Duncan. They were married in 1828 and immediately started for the West. Brought up in the luxurious homes of the East, Mrs. Duncan was impressed by the crudeness and hardships of life in the West, and has left some amusing accounts of her experiences. Later, when she came to live in Jacksonville, she became deeply attached to the people and the life in Illinois. She was a small, frail woman, with intense religious feeling and great refinement of manner and speech. Mrs. Putnam, in the last year of her life, spoke with feeling of all she owed her mother, of the unconscious influence of her simple, perfect manners and strong religious views upon the young, impulsive girl.

The hospitality of the Duncan home in Jacksonville was unbounded. There were no hotels, so all the weary travellers and politicians were made welcome at "Elm Grove." Here, in 1837, came Daniel Webster and his wife, and a great barbecue was held in the grove near the house.

Mr. Duncan was devoted to Mary, who was his eldest daughter, and made her his constant companion, teaching her to ride and taking her hunting with him. Every incident left an indelible impression upon the mind of his daughter, as the days of their companionship were few. Governor Duncan died suddenly on January 15, 1844, when his daughter Mary was but eleven years

old. Later, she never wearied of telling to her children her father's experiences of frontier life and impressing upon them his strong love of truth, sincerity, and courage, and his motto, of which her own life was a constant example, "True politeness is kindly feelings, kindly expressed." Through a correspondence of nearly fifty years with members of her family, no anniversary of his birth or death is forgotten, and the Christmas season always recalled the joyous carols the children used to sing in the old hall at "Elm Grove" and the rapturous opening of the stockings with original toys made by Governor Duncan.

After Governor Duncan left politics, he engaged in many large business enterprises. Unfortunately, he signed the bond of a man who proved a defaulter. This happened just before his death. Had he lived he could have met his obligations easily, but, as it was, a large portion of his estate was sacrificed, immense tracts of valuable Illinois land selling for twelve and one-half cents an acre.

Mrs. Duncan was left with seven children, but she courageously tried to meet every obligation. The family owned a large house and considerable land, which came from Mrs. Duncan's estate and could not be sold until the youngest child was of age, but there was little ready money. During her girlhood Mary Duncan learned to do everything necessary in the economy of a large household. It was in the days when neighbors helped in all times of trouble. We read in one old letter, quite as a matter of course, of the girl of fourteen "sitting up" all night with a friend's child who was ill. Later in life this training was most valuable and she was always a wonderful nurse.

Jacksonville was an unique town. There was a delightful mingling of the best New England settlers brought there by the founding of Illinois College, full of enthusiasm for a simple, intellectual life, and of a small colony of Kentuckians, with their cordial hospitality. It produced a society which has preserved its charm to this day. The fine elm-lined streets remind one of New England, but many of the houses have a distinctly Southern air.

A warm personal friend of Governor Duncan was Colonel John J. Hardin, who was killed at the battle of Buena Vista in the Mexican War. Colonel Hardin, one of the foremost lawyers in Illinois, was able to save the trust fund belonging to Mrs. Duncan's estate, and administered the property so that there should

be money for the education of the children of his friend. The girlish friendship between the two daughters, Ellen Hardin and Mary Duncan, was continued through the many vicissitudes of their lives. It was at the home of this friend, who married a son of Chancellor Walworth of New York, that Mary Duncan met her future husband. Mrs. Walworth is still living in Saratoga Springs and last year spoke of their girlhood in Illinois. School books were a great luxury and one copy sufficed for several girls. There was intense earnestness in all they did. The uncertainties of life in those early days taught them to value every opportunity, and a deep religious feeling, shown in the old yellow letters that Mrs. Walworth still prizes, permeated the simple, healthy life of the girls. It was an outdoor life. The girls had their saddle-horses and rode nearly every day. Both of them, later in life, laid great stress on the benefit, physically and mentally, of this feature of their life.

When Mary Duncan was thirteen she accompanied her mother in May, 1846, on a trip East. It was a serious undertaking in those days. They visited Mrs. Clark in Washington, who lived in a beautiful home on Lafayette Square, opposite the White House. The house is still standing, one of the stateliest of the old mansions. On the corner nearby lived "Dolly Madison," the widow of President Madison. Writing in 1892, from Washington, Mrs. Putnam recalls incidents of her early visit, dinners at the President's and at Daniel Webster's, and the ceremonious life at her aunt's; "Yet all this grandeur did not fill me with a desire for its long continuance, for I remember thinking silently that the freedom of my prairie home was much sweeter. But I was enraptured with Mrs. Madison,—lovely Mrs. Madison! It was a delight to us young people to pay our respects to her very often, when she received us in turbaned cap, with the dignity of a princess, and with the urbanity of a truly loyal American woman. We do not see such a type of womanhood now-a-days. Another pleasant memory of Washington, on a later visit, was watching the sculptor, Mills, who was making the equestrian statue of Jackson now in the park. I was also interested in the finely-trained horse that was his model, which I used to see put through its paces, in the Smithsonian grounds, as I walked across them to my uncle Josiah Caldwell's."

There is a characteristic letter of her's written during her visit of 1846, to her youngest sister, describing a May ball she attended. It shows her keen observation and interest in people even at that early age. She writes: "I was introduced to about 9 boys and 10 girls and I talked to 7 girls that I did not know from Adam." Then, with the naturalness which was always her great charm, she advises her sister to be good, adding, "I am very sorry I was not more obedient to Cousin when I was at home. I would have felt so much better now I am away." She always spoke of this visit as marking an epoch in her life. It aroused her ambition to study and prepare herself to take her place in the world that always interested her. She was ever a believer in travel as a means of broadening one's view of life.

In 1847 came another trip to Washington. Mary Duncan describes the journey in a letter. "We went in the cars to Naples, which was entirely inundated. After spending a terribly long day there, we proceeded on board the 'Prairie State,' the finest boat on the Illinois, and arrived in St. Louis just in time to take the boat for Cincinnati. Every one was pleasant on board, and we had good company within ourselves. . . . A severe attack of fever prostrated me on the second day of our leaving Cincinnati;" but she was better "two days later when we arrived at Pittsburg and took the Brownsville boat. In the stage across the mountains there were many pleasing incidents that occurred that day; but I defer detailing them till I see you face to face. We arrived at Washington Saturday night as usual, but what was our disappointment at finding Aunt Anna Clark breaking up housekeeping and going to board. So of course our visit to her was knocked in the head. We are happily situated with Cousin" [wife of Col. Hamilton of Bladensburg, Maryland]. "There are more negroes collected here than I ever saw in my life." Then comes a characteristic touch: "I have promised 30 girls to write." She was always sociable!

In 1850 Mary Duncan went with friends to New Orleans, where she remained some weeks for a very gay visit with some Caldwell cousins.

Mary Duncan received her school education at Jacksonville Female Academy. The number of studies were few, but they were learned with a thoroughness rare now-a-days. She was for-

tunate in having for a teacher Miss Lucretia Kimball, now Mrs. Kendall, who came from an Eastern home to instruct these minds of which "neither age nor poverty could blunt their intense desire for knowledge." Mrs. Kendall is still living, honored by her pupils to whom she brought not only love of the best literature, which she read to them out of school hours, but a deep religious faith. Mrs. Putnam attributed much of the success of her life to the high aspirations inspired by the rare personality of her beloved teacher. Mrs. Kendall, in speaking of her former pupil, said it was given to but few teachers to see the beginning, the fulfillment, and the completion of such a full life.

Mary Duncan was graduated from the Jacksonville Female Academy in 1851 and in September visited, with her mother, in Chicago, having entertainments given for them by Mrs. Newberry, Mrs. Kinsie and Mrs. Blatchford. The winter was spent in nursing a beloved sister, Elizabeth, who, in spite of all that devotion could do, died in June, 1852. This loss was followed two months later by the death of Hannah, a younger sister. The family now consisted only of Mrs. Duncan and three children, Mary, Julia, and Joseph. In April, 1853, they went East, visiting Washington, West Point, and Saratoga Springs. At the latter place Mary Duncan met Charles E. Putnam, and they became engaged. Mr. Putnam had expected to practice law in New York City; but as Mary Duncan had inherited her father's strong love for the great rolling prairies of Illinois, and belief in the future of this country, she persuaded Mr. Putnam to visit the West. He located in Davenport, Iowa, in the spring of 1854. They were married December 9, 1854, at "Elm Grove," Jacksonville, Illinois. Mr. and Mrs. Putnam arrived at Rock Island on Saturday, January 9, 1855, too late to cross the river to Davenport. They came over Sunday morning and attended church twice that day. It was characteristic of Mrs. Putnam that she presented her letter to the pastor and was admitted to the First Presbyterian Church the following Sunday. She never wasted any time in indecision. Mr. Putnam was a partner of Judge Mitchell, a prominent lawyer; but the times were hard and their income, for the first few years, of the smallest. The first winter the young couple boarded, and their home consisted of one room. Mrs. Putnam, though she had left a home filled with fine old

mahogany furniture, writes most cheerfully: "You don't know what a beautiful table I have made me, covered with red calico. Charlie and I sit beside it each night and read and sew." This first winter they read Milton's life and works and Addison's works. Mr. Putnam was not fond of general society, but to the intimate friends who knew him in his own home, he was the most genial and delightful of companions. The custom of spending the evenings in reading aloud was continued throughout their married life of thirty-three years. As the family grew, the children brought their work, drawing, models of ships, or whatever it might be, around the large tables, and worked, while Mr. Putnam read from the standard authors in one of the richest and most melodious of voices.

On July 30, 1855, Mrs. Putnam writes of an event fraught with great consequences to Iowa: "The first locomotive that has ever puffed its steam into the State of Iowa has just passed by. You don't know what an excitement there was all along this street, and indeed all over Davenport, last week when the 'Antoine Le Claire' made its first visit. The track is only laid down a little way—that is, five miles now, but not a mile then,—and it is truly an era in the town and state. You see, the engine is named for one of our citizens, and his likeness, cast in bronze, is on either side. This, with a visit from the Indians, has added new life and spirit and something to talk about the last three weeks."

At this time Mr. and Mrs. Putnam were keeping house in a small house on Fifth street between Perry and Rock Island streets. On October 18, 1855, their eldest son was born at "Elm Grove" and named Joseph Duncan, after Mrs. Putnam's father. The next few years were devoted to the care of her rapidly increasing family.

Mrs. Putnam's letters reflect her interest in public events. A letter written to her mother, January 27, 1860, shows strong feeling: "You ask what I think of our country? Read Seward's speech in the Senate—'them's my sentiments;' but still I do not fear war. God is a God of mercy as well as justice. Oh, if each one of us would pray as we ought—lead the lives we ought in all things—God would avert his judgments. Let us strive each to be as peaceable and forbearing with each other as we can. No wonder nations quarrel when families and countries don't agree.

God have mercy on our country, have mercy, have mercy! He is our only help in this our sorest time of need!"

When the war was inevitable, Mrs. Putnam worked with her usual enthusiasm to aid the soldiers. A letter written September 26, 1861, says: "We have established a Soldiers' Aid Society today, and in my absence they appointed me secretary. I feel very incompetent to do my duty to such an office and attend to my little family, but Charlie insists on my taking it and promises to assist me all he can. . . I have almost knit a sock for the soldiers since Tuesday night, by just picking it up when riding, nursing the baby, or giving orders in the kitchen." On February 3, 1862, is the first mention of any lecture entertainment Mrs. Putnam ever undertook. In the light of her successful work of later years, it is amusing to read of the door receipts of a lecture by Dr. Fisher, for the benefit of the Soldiers' Aid Society—certainly a worthy cause—being but $18, while the expenses were $24. "But he was generous enough not to let the Soldiers' Aid Society lose that. I had to work very hard to get even this money out. . . I had to see to all things regarding the lecture myself and, depend upon it, I will never have anything to do with such an affair again."

But when Mrs. Putnam's interest was once aroused it was impossible for her not to go on. In February there is a report of a battle and "Mr. Powers has just been here and brought me $50 from the gentlemen. They raised over $600 yesterday for the relief of our wounded. I've been out this morning, seeing what I could get. We will have an extra meeting tomorrow and next day, and work all we can. Mrs. Rogers, our treasurer, is sick; Mrs. Newcomb, our president, out of town; so all the responsibility falls on me."

Mrs. Putnam's interest in the Academy of Sciences grew out of the love of her eldest son and was so interwoven with the currents of her family life, that a true picture of her could not be drawn without emphasizing her life as a mother. Her work for the Academy was the outgrowth of a mother's love such as is rarely seen. She herself, in alluding to a proposed life of her father, says: "If you would write little home incidents, some home characteristics, they after all make up the greater part of a man's character and add much to the interest of a history."

Her own letters give the most vivid picture of her life. January 8, 1863, upon receiving the *New York Observer*, she writes: "I read every word of it and all that could interest the children. The red ants seem to take Duncan. Oh, mother! what a luxury to have boys old enough to appreciate what you read to them! I have so much pleasure in watching the development of Duncan's mind. My whole days are spent in instructing, playing with, and keeping the children clean. I sew scarcely a stitch and fear my industry will flag; however, I never was so busy in my life—or more happy." Mrs. Putnam fitted up a school room in her house and for several years taught the older children each morning.

The summer of 1863 was spent in Saratoga Springs. Mrs. Putnam had recently become interested in the works of Froebel and began giving the children object-lessons from nature. On January 11, 1864, she writes: "Duncan astonished his father and me by his questions. I fear to have him learn to read,—still let him say his lessons to me daily. Indeed, I do little else but teach manners, morals, reading, spelling, geography, and Bible from morning till night. . . I feel rewarded, as I go around and seal the foreheads with a mother's sacred kiss, for all my toil and care, and would not exchange my lot for that of the most idle woman in the world. A young lady visiting here said I had the most delightful home in Davenport. I felt it was indeed the truth."

And again, on March 9, 1866: "There is not an hour I spend with my children, in their instruction and improvement, that I am not triply rewarded. . . . I had 28 to dinner last Saturday. We had our bees robbed one night last week and the boxes broken up and the little helpless things scattered everywhere. I gathered them up next day and was badly stung for my pains. I suffered very much, but could I have saved my bees, I would not have cared. They are all dead."

On February 27, 1864, Louis Agassiz lectured in Davenport. Mrs. Putnam writes of spending the morning in reading about glaciers. It was characteristic of her to the end of her life to prepare herself so as to appreciate and understand any new subject. She availed herself of all the opportunities that came to her. She, with her son Duncan, had the pleasure of meeting Agassiz later at Mr. Hirschl's.

In May, 1863, the family moved to a beautiful country home, "Woodlawn," about two miles from the center of the town, on a bluff overlooking the Mississippi River. The place of eighteen acres was laid out by Mr. Mackenzie, an Englishman, in a combination of lawn and wild woods. Both Mr. and Mrs. Putnam became interested in horticulture, their enthusiasm being shown by the purchase of technical books as well as by the planting of an orchard, garden, and vineyard. Here was founded an ideal home.

Mrs. Putnam led an active outdoor life superintending the garden and grounds, encouraging her sons to be interested in all the affairs of the place. She was their companion in all things. She learned to swim, with five of her sons. For some years Mr. and Mrs. Putnam attended a class in a gymnasium in town, often walking the four miles there and back in the evening. This outdoor life was what gave her the strength to carry out her plans and accomplish her great work in life.

On Thanksgiving Day, 1865, Mrs. Putnam writes: "To one and all the dear ones at home I send greetings on this our first great Thanksgiving Day, the grandest day of thanks our country has ever known; freedom in the letter as well as in the spirit; universal hope and renewed hope and renewed life to our land. Proud am I that I am American-born, proud to have six sons to claim this glorious country as their native land; while my heart swells with pride of land and country, my hands are busy about the ordinary affairs of life; and while my heart yearns over my children and their future, their present wants of bread and butter and clothing press heavily upon me, and I cannot spare the time even to jot down all my thoughts and aspirations for them."

The years passed swiftly in the home life, and in attending to a large household, with many guests coming and going. The surplus of the large garden was sent to friends. Neighbors tell of how Mrs. Putnam would stop and distribute flowers and fruit to the children as she drove to town. There was no pleasure to her in having things unless shared with others. Even in the first year of their housekeeping, in 1855, Mrs. Putnam writes of supplying the whole neighborhood with fresh vegetables from their tiny garden; and again in September, 1872, she writes: "We have so many pears and grapes that I want every one to come and enjoy the place, the fruit, and every thing, while I have so

much. I have entertained, I believe, one hundred people at least this summer, a few at a time."

These years were probably the happiest of Mrs. Putnam's life. She writes in 1871: "I am sitting in my conservatory, surrounded by my beautiful flowers, God's special gifts. . . . Life seems so gay and beautiful."

In 1872 came a terrible scourge of scarlet fever; eight children were ill at one time, and the eighth son, Hamilton, died. This was the first break in the family circle.

The next winter, 1872-3, a printing press was purchased, and the older boys began printing a magazine, *The Star of Woodlawn*, and other papers. A finely equipped carpenter shop facilitated the making of canoes and sailing boats. Theatricals were given during the winter for several years, on a regularly equipped stage, with drop curtain and all the accessories. There were historical societies, where original papers were read every week, a stamp company, and a juvenile savings bank. Everything was done to encourage the children to develop plans and carry them out successfully. The parents believed also in recreation and provided a billiard table, riding horses, and all the outdoor sports. Mrs. Putnam writes, in July, 1873, urging her mother to visit her and "let a little of the full glow of happiness that so fills my heart and life to overflowing flow into yours, and feel the full influence of the buoyant young life that so fills this household."

In the fall of 1873 the eldest son, Duncan, returned from an expedition to the Yellowstone under the command of Captain Jones. It had been thought that the outdoor life would strengthen him so that he could go to Harvard; but he returned with a severe cold, which, during the next winter, developed into tuberculosis. It was the beginning of a long battle for life, lasting eight years. Out of the shadow of this sorrow, Mrs. Putnam came a stronger but an older woman. The gay and joyous note of the letters has gone to return no more.

The letters tell their own story, December 1, 1873: "The Doctor says Duncan is not able to study or go to college for years, if ever. We have talked the matter over deliberately, my husband and I. I feel that we must make every sacrifice to accomplish [his restoration to health]."

January 1, 1874: "Tomorrow night the children will go

through their play of William Tell. Mr. Putnam insists on making the home lively and pleasant for Duncan as long as he is with us. It will be absolutely necessary to send him away from home, and very soon. He had a hemorrhage in the street the day before yesterday, which alarmed us all very much."

January 21, 1874: "I leave Duncan scarcely a moment night or day. His father sits with him sometimes while I do some errands. I don't know what to do with him. If he sits still he reads Huxley and Darwin and all the other brain-splitting books you ever heard of—says histories are almost as heavy and stupid as novels. He was actually relieved when we were through David Copperfield. I suppose while he lives he will work."

January 30, 1874: "Duncan is anxious to go with Dr. Parry to Utah next summer, as it is on the desert and near the mountains, so he can catch all kinds of bugs. Oh, that God would spare his life that he may fulfill his great promise. . . I've been setting type to-day. George and I run races which can distribute the fastest. I am learning lots about printing and becoming fascinated with the work."

February 4, 1874, a letter to her mother: "Duncan has been very ill. I have had no heart to write. To-day he is back in his bug room which makes him and me more cheerful. This is the fourteenth hemorrhage in six days. I have not left Duncan a moment day or night; how long I can hold out I don't know. Pray for me and mine, dear mother.

"Your loving child, MARY."

February 15, 1874: "Yesterday I took Duncan to spend the day with Mr. Pratt; he afterwards went to the Horticultural Society, and they made him Secretary pro tem. I went up for him there. He was such a boy, writing the minutes of the meetings, surrounded by gray-headed men. He the only child in the midst and doing the hardest work. However, it interested him and I cannot see that it hurt him any."

March 5: " . . . I have been setting type to-day, so has Duncan. The boys have printed off my piece—I set every word of it myself."

On March 18, 1874, the eleventh child and tenth son was born. A few weeks afterwards, when Mrs. Putnam was driving with her son Duncan, the horse became frightened and ran. Mrs.

Putnam was thrown out, striking the sciatic nerve. She was unable to move for weeks, and never fully recovered from this injury. In September of this year she joined her son in Colorado. A month was spent most delightfully in camping in a log cabin at Empire City. Five children were with her and five were left in Davenport. Two botanists, Dr. Engelmann and Dr. Parry, were collecting in the mountains. They, with their wives and Mr. and Mrs. Ballord of Davenport, made a pleasant party that gathered nightly around the fire of pine knots in the cabin.

Mrs. Putnam returned home in September, leaving Duncan to spend the winter in Cañon City. During this winter Mrs. Putnam read all his lessons to her third son, John, whose eyes began to trouble him. It was through her eyes that he was enabled to graduate with honors from the High School. One wonders where she ever found the time to accomplish all she did. Her household cares were always arranged so that there was time to be with the children, when out of school. She had the great gift of realizing what was the most important thing to be done. She wasted no time over the non-essentials.

On February 4, 1875, comes a record of the first effort to raise money for the Academy of Natural Sciences, the beginning of almost exactly twenty-eight years of work for the association. At the time Mrs. Putnam was forty-three years old, the mother of ten living children, and with the multiplied cares of a large family and a wide social circle, she would have been entitled to retire from active work. But the voice of her eldest son, an exile for his health, came to her, urging her to do something "to make the Academy popular." She writes to a friend, speaking of one subscription already received: "If all the patrons of the library were as liberal to the Academy, I will not have more to do to get my $500 than I can do with my hands thus tied with my sick children. Why should not the two institutions work side by side and be one in spirit as they are in fact, each struggling for the advancement of knowledge in our midst, each helping on to the investigation of truth, could they not be made a crown of glory to our town?" A hope which is at last being realized.

On February 11, 1875, her youngest child, Berthoud, died. This loss was deeply felt by Mrs. Putnam. She writes of how

empty her life seemed, the first time for twenty years that there was not a baby in the house, to be the first consideration. Those who knew Mrs. Putnam can see how naturally grew her interest in the Academy, which she would sometimes laughingly call her twelfth child.

Mrs. Putnam was elected a member of the Davenport Academy of Sciences June 2, 1869, at the same time her son Duncan, a boy of thirteen, was elected. He had been interested in the Academy almost from its beginning and insisted that his mother must become a member at the same time. She was the first woman member. The Academy had been organized on December 14, 1867, by four men. The meetings had been held in various offices until, in 1868, a "very liberal offer was received and accepted from the Young Men's Library Association to have the Academy deposit its cabinet and hold its meetings in the Library rooms, corner of Second and Brady streets." It may be noticed that the singular noun covers the extent of the museum. Here the "cabinet" remained in a dark corner until the fall of 1872, when the meetings were held for some time in the law office of Putnam & Rogers. Mrs. Putnam never made any pretense to being a scientist herself, but she frequently accompanied Mr. Pratt and Duncan on their Saturday excursions for shells and insects.

In March, 1875, Mrs. Putnam, assisted by other ladies, furnished the bare Academy room with matting, shades, and cases. A letter of June 2, 1875, to Mrs. Parry, tells of further work: "Duncan and I attended together the Academy meeting the other evening. . . There was a large attendance, and Duncan seemed wonderfully pleased with the looks of things and the large donations sent in. . . I presented eleven ladies' names [for membership] the other night; this will make twelve. The cases look so nice, and many other things are waiting to be arranged; Duncan's collection fills one-half a case." Then, with a prophetic look to the future, she continues: "I wish we had a fire-proof building. . . I wish the Doctor could induce some of those rich societies East to send us $1,000 as a nest egg to secure some property here for that purpose; now while the enthusiasm is freshly awakened we must not let it die out until something is done. I like the plan of endowing the institution so as to secure some one to spend all of his time there, making exchanges, etc."

On September 2, 1875, Mrs. Putnam writes: "Duncan thinks the Academy has at last done something in that it has sent Dr. Farquharson to Detroit. Well, I, too, have found a new interest in the Academy in that it has resolved itself into a Home Missionary Society. There is an old man, Captain Hall, very much interested in the Academy, who goes up and down the river in his boat every day and he has a locker in there filled with Sunday School books for the little children all along the shore, and when they see him coming they run down to the shore with their stone axes and arrows and give them to Uncle Hall—so he brings in many things every few days to the Academy, and for these he has distributed 460 books to the children in the last three months. Now, my dear mother, where can you find a nobler work? All the parents of these children are going to visit the Academy thro' Fair week and we expect to interest them to bring in many more things," a hope which was realized, for on October 31st there is mention in a morning paper of a long list of donations to the Academy. For years afterwards Mrs. Putnam collected Bibles, old school books, illustrated papers, money, and groceries to give to Captain Hall. It is largely due to his efforts that the Academy has one of the finest collections of Mound-builders' relics and ancient pottery from the Mississippi Valley.

The country was deeply interested in the Centennial celebration, which was to occur in 1876. Women were urged to send samples of their handiwork to the "Woman's Pavilion" at Philadelphia. The enthusiasm of the women of Davenport was diverted into a new channel, which has had ever widening influences and has been of inestimable benefit to the town. We read of the beginning of the Centennial Association in a letter from Mrs. Putnam to Mrs. C. C. Parry, written September 17th, 1875: " . . We had a most enthusiastic meeting yesterday of the ladies. I was so tired last night I could not sleep, what with shopping, making calls in the morning, arranging about my grapes, sending to Rock Island for the young ladies, having them to tea, going up immediately after to a lecture on the Mind . . . I wonder I don't feel more tired today, but I don't. Our Academy rooms look lovely. Mrs. Silsbee, Mrs. Price, and Mrs. Clark sent flowers. . . . It seems to have been well understood that the meeting was called in behalf of friends of the Academy and most

noble was the response and enthusiasm. Mrs. Potter took the chair, and I made a speech about the necessities of the Academy, and its great work. I think it was a little 'stumpy,' but upon a vote being taken whether such an organization for the Centennial, having the Academy as its legitimate finale should be had, a most enthusiastic 'aye' was responded. . . . About 30 ladies were present." The effects of this meeting were far-reaching in the history of the Academy. The Ladies' Centennial Association published the first volume of Proceedings.

We can realize the interest women were taking in the Academy when out of a list of eighty-three new members this year, we find forty-three were women, all personal friends of Mrs. Putnam, so it is not difficult to see how their interest originated. She was succeeding in "making the Academy popular."

On November 26, 1875, J. Duncan Putnam introduced a resolution at a meeting of the Academy to publish the Proceedings, giving the following reasons: "1. It will preserve much material that might otherwise be lost. 2. It will furnish greater incentive to our members to make original investigations. 3. It will increase the library by means of exchange with other societies and publishers. 4. It will place us on a creditable footing with the other societies of the world." It was voted to publish them, and on December 20, 1875, the offer of the Ladies' Centennial Association to print the Proceedings was accepted by the Board of Trustees.

To raise the money necessary was a serious undertaking in those days. We read in a letter of Mrs. Putnam to Mrs. Parry, December 29, 1875: "We want to have a grand entertainment the 22nd of February; hope to make $200 clear. I have been successful in raising, from the Academy gentlemen mostly, the sum of $183 for publishing fund. I promised $200. . . . I have had some amusing experiences in studying human nature this winter and am more astonished than I can tell you at opposition to this project from sources little expected. . . . The Academy men are working right hard to get their Proceedings ready. We want the book to be Centennial and worthy our city. . . . Nothing but the publication keeps him [Duncan] alive. He and Mr. Pratt visit the engravers, go after the drawings of axes, flints, arrowheads, etc. He gets up town to the Academy rooms every

day, most always twice a day. There are more visitors there in one day now than there used to be in weeks."

On January 8, 1876, Mrs. Putnam writes: "We had quite a meeting of our Centennial ladies who are to appoint committees for our next entertainment on Monday next. I get out of all these duties by raising $200 from the members and others. . . . The ladies voted $100 of their money and are going to raise money to the amount of $600, with my $200, and assume the publication. We have a board consisting of Mrs. Magonegal, Mrs. McCullough, Mrs. Sanders, and myself to look after the publication; having already, (or rather Duncan and Mr. Pratt have) received offers from several engravers and publishers; and we can have about 25 pages of engravings and wood cuts for about $200. . . . Let our Centennial issue be worthy the name."

February 9, 1876: "We are having a lively time over committee meetings, etc., . . . and lots of nice things are happening for the Academy every day."

The Centennial Association planned an elaborate series of entertainments to raise the sum of $600. The first entertainment on February 22, 1876, was very successful; but in the early hours of the following morning the building in which it was held was destroyed by fire, occasioning losses of about $1000 to persons who had loaned articles for the entertainment. The association felt bound to repay these. The first pages of the Proceedings have been started, but the Academy, on February 25, passed a resolution of thanks and sympathy and suggested the postponing of the publication. The women courageously refused.

On March 10, 1876, Mrs. Putnam writes: "We undertook a great enterprise and have done wonderfully well indeed. I never heard of anything like it. We have raised at least $1500 in a little over two weeks; paid off our debt, and have on hand $365 for our book. I have devoted hours every day to the work and hope my labors are over."

March 17: "I have been led into more public life than I think either agreeable or necessary of late and feel very happy to retire into private obscurity of home again. I attended the last meeting of our Centennial Society Wednesday, and audited all the accounts. In three weeks we have raised enough money to pay all debts incurred by the fire, $1000, and have $450 left in the bank for

publishing our book. The citizens have expressed great sympathy and done a great deal for us. I shall devote myself to my garden this summer." She also writes at this time of reading his lessons to her son John, for three hours a day, and to the children two hours every evening. An old list, kept by one of the children, shows an astonishing array of books read to them by Mrs. Putnam: — histories, travels, Scott's novels; and four times did she read aloud to successive groups of children the unabridged edition of Robinson Crusoe, not omitting the religious discourses.

March 27, 1876, Mrs. Putnam writes to Mr. Parry: . . . "If you have received the late dailies you must be pretty well posted as to what all my outside life has been these last busy weeks, but they tell not half the story; how through discouragements we have come out victorious. Even fire could not quench our zeal, and never for a moment have I felt with some that we must postpone our work of publishing. . . . They are thinking of forming classes in the Academy and letting those interested in special subjects meet together and report to the Academy. Duncan is urging this very much, and will take the chairmanship of the zoölogical department. . . . You never knew anything like the warmth and sympathy every one has expressed for our misfortunes." The Bric-a-Brac Club gave a loan entertainment which helped materially to pay the debt caused by the fire.

In August of this year Baron Charles R. von der Osten Sacken, a distinguished Russian entomologist, visited "Woodlawn" to meet the young entomologist, Duncan. He has been an honored friend of the family ever since and has contributed a scientific paper to this Memorial volume. He was one of many who showed their appreciation of the remarkable work done by the invalid boy, self-taught, working out his ideas alone in this Western town, far from the influence and help of college or museum. His work was done with such thoroughness that to-day, after a lapse of twenty-five years, it is still the authority in the lines of work he took up.

In September, 1876, Mrs. Putnam and her son took the first copy of the Proceedings to Philadelphia and placed it in the Pavilion at the Centennial as a sample of woman's work in a Western town. They then went to Washington, where Professor Henry,

Secretary of the Smithsonian Institution, became so interested in the work of the Academy that he placed its name among the first on the list of foreign exchanges for scientific books. On October 14 the Publishing Committee of the Ladies' Centennial Society reports "Vol. 1, published by them, as now complete and placed at the disposal of the Academy." Nine hundred and ninety copies were received; two hundred and fifty were distributed to subscribers and four hundred and fifty-six to the scientific societies. The volume received praise from all parts of the world from those interested in the progress of science.

A rather detailed account has been given of the publication of the first volume, because it was a unique enterprise for women and also because it accounts for Mrs. Putnam's future interest in the publication, an interest that continued through her life, and by her endowment will go on in perpetuity.

At the urgent solicitation of Mrs. Putnam, a few months later, on February 22, 1877, her old friend, Mrs. Patience Veile Newcomb, gave a lot on Brady Street to the Academy of Sciences, "To show my appreciation of its worthy objects and because of the great regard I entertain for my young friend J. Duncan Putnam, and my admiration of the noble work he is doing in its behalf." Plans to build were at once commenced. Mrs. Putnam and Mrs. Sanders were elected on March 6, 1877, a committee to procure subscriptions for a new building. The required amount was raised by Mrs. Putnam, Mrs. Sanders being unable to act.

A "Kettle Drum" entertainment was given in July, 1877, at "Woodlawn" by Mr. and Mrs. Putnam for the benefit of the Academy. Between seven and eight hundred people were present. It was a perfect summer's night, and it was the most successful fête ever given for charity in Davenport. The amount realized, eight hundred dollars, was so encouraging that two days later the committee on building reported in favor of erecting "a plain and unpretentious edifice, sufficiently large for the present needs of the Academy but not so large as to leave it in debt."

The corner-stone was laid on October 4, 1877, and on February 22, 1878, a year from the gift of the lot, the new building was opened to the public. There were on exhibition an art collection, copper implements from Wisconsin, eight microscopes, and

a beautiful collection of butterflies. Though the admission fee was but twenty-five cents, the net proceeds were four hundred and fifty dollars. The Ferry Company, through the interest of Captain Robinson, a lifelong friend of the Academy, carried all ticket-holders free from Rock Island, which shows the universal interest felt in the starting of this little institution.

In January, 1878, an Art Association was organized and held its meetings in the Academy building. The society existed for several years, holding a number of exhibitions. It was always an earnest desire of Mrs. Putnam's that the fine arts should have a place in the Academy's work, and that the Academy should be an institution for the broadest culture.

On August 4, 1878, there is mention of future work. "I have had the circular room in the basement finished; it does look so beautiful, and will give us room for all the curiosities we can collect. I have had the lathes, nails, and sand given to me, and I had enough money in the bank, left from the festival, to pay for the work; so now I have accomplished what I started out to do" (a statement true of her whole life). Mrs. Putnam often spoke of laborers volunteering to give a day's work to help build this institution, and took pride in the development of the Academy from such small beginnings.

Mrs. Putnam was elected President of the Academy on January 1, 1879. It was an honor she always deeply appreciated. Dr. Parry, in nominating Mrs. Putnam as President, said: "It is quite unnecessary to explain to any one here present that the actual success and present prosperity of the Academy has been coincident with the interest taken in it by women. It was a Women's Centennial Association that first inaugurated and successfully carried out the publication of the Proceedings, on which more than on any other one thing the scientific character and standing of the Academy abroad has been firmly established. The very ground beneath our feet is the spontaneous gift of a generous woman and this commodious building, which affords us a permanent home, from lowest foundation stone to highest roof-crest, if not the direct work of woman's hand, has been wrought out and completed under the inspiring influence of woman's heart."

The years were full of busy plans to raise money for the Acad-

emy, of which we have no record, except the occasional mention in the Proceedings of the proceeds of a lecture or entertainment. An unfinished letter which survived the destruction of "Woodlawn" gives a picture of what work these entertainments entailed. It was written just after a concert given by Sherwood on May 23, 1879: "From day to day I haunted the editorial chairs, buttonholed the local editors, made journeys to Rock Island and back again, had tickets printed at one office, placards at another, and the programmes at a third. These tickets I was very judicious with, giving some fifty to the editors, and about as many more to music teachers and those promising to interest their pupils. The placards I took to Rock Island, left them with a friend who saw four of them put in the street cars. (We sold four tickets in Rock Island). . . . The other placards I took in my buggy and put in front of windows, and sent John to street car lines to have others put in cars. This was no small part of the work, for the next morning after leaving them they did not appear; so I had to see first one driver and then another about it. At last Sherwood was fully understood to be coming. You could not lift your eyes along the principal streets that 'Sherwood, the greatest pianist in America, Burtis Opera House, May 23,' did not meet your eye. These immense placards haunt my memory. Then the programmes: how to get them up was at first a mystery to me. . . . They were to be dainty and unique. . . . The 'opinions of the press,' which the agent sent me, had been placed in the hands of the local editor to make extracts from day by day, and which by the way he never used. Now, you must know our 'City Local' is a hard man to find, as he sleeps all day and writes up his locals at night. After many delays the programmes came out, 1000 of them. My presence with the old blind pony on the street corner seemed to be the sign for the gathering of all the musical men, and I would hardly have stopped before they would flock around the buggy and talk over the prospects, and one after another would start off to find some enthusiastic person who needed only to be told about Sherwood to bring in a dozen men." The letter lies unfinished. A few days later, May 27, came news of the death of the third son, John, at an Eastern college.

In her annual address, read January 7, 1880, Mrs. Putnam regrets that she had not been able to do more work for the Acad-

emy, on account of the great sorrow that had come to her; she speaks of the afternoon talks given by Mr. Pratt, Dr. Parry, and others, and adds that "the familiar lectures and classes have been established with a view to secure the interest and coöperation of the pupils of our city schools. If the results in this direction have not as yet proved all that could be desired, or reasonably expected, it is still a matter of congratulation that at least some earnest efforts have been made to place the Academy on its legitimate basis as an educational institution." In the spring Mrs. Putnam had arranged a botany class under the direction of Dr. Parry.

Thus was inaugurated a movement which Mrs. Putnam and the other workers in the Academy had had in mind for years: the teaching of the school children natural history in the Academy. This work was carried on from time to time by Mr. Pratt. It is gratifying to know that twenty-three years later, just before her death, Mrs. Putnam had the deep happiness of seeing this movement regularly organized and the children coming by the hundreds, to the Academy to study its collections and receive systematic scientific instruction.

These were anxious years, watching over the failing health of her eldest son. Mrs. Putnam accompanied him on his short trips, one being to Des Moines in 1881, in the endeavor to have a state entomologist appointed for Iowa. What is now regarded as an economic necessity was then regarded as a most visionary extravagance. Of her visit to the legislature Mrs. Putnam writes: "It recalls the days when I heard Clay, Webster and Calhoun, in Washington; a little different, it is true, still the same feeling came over me."

The publication of Vol. II of the Proceedings was the individual enterprise of J. D. Putnam and was begun in February, 1877. One result of the publication was to bring in large numbers of scientific exchanges. Mrs. Putnam writes in August, 1878: "Our library has gotten a great start and is filling up very fast. We have put the books up in the Art room, and they set off the room beautifully."

No sooner was Vol. II completed than Vol. III was started under great difficulties. The amateur printing press was moved from "Woodlawn" to the basement of the Academy; and here the typesetting and proof reading was done in the most economical

manner, most of it by J. Duncan Putnam. Out of such sacrifices grew Vol. III.

At page 128 of the volume the labors of J. Duncan Putnam ceased. He died on December 10, 1881. He was one of the sincerest seekers after the truth, gentle, modest of disposition, entirely forgetful of self in the enthusiasm of the aim in view. He had crowded into his brief span of twenty-six years the work and enthusiasm of a long life. To the mother who had watched over him for eight years, who had been his comrade in every enterprise, who had built up the Academy for the sake of bringing a bright look on the wan face of the invalid, to her his interest in the Academy descended as a sacred legacy.

Naturally, Mrs. Putnam's work in the Academy went on. On January 27, 1882, she was appointed Chairman of the Publication Committee to succeed her son. From this time until her death her interest in the publication never lessened. The year was spent in arranging the papers of J. Duncan Putnam. With the assistance of Prof. Herbert Osborn his scientific work was completed and published in Vol. III, which was appropriately made a memorial volume.

On October 29, 1882, Mrs. Putnam writes to her sister, Mrs. Edward P. Kirby, Jacksonville, Illinois, "I sent you sheets of the Memorial Volume for my gift. It is more than gold to me, the perpetuating the memory of such a boy;" and a little later: "I am so happy in this glorious work of my beloved son. I wonder if any one ever did so honor and love a boy. God bless his precious memory!"

In April, 1883, a special meeting was called, and an effort was made to raise the indebtedness of the Academy. Not only was this done, but over $1,000 was left as an endowment for the institution. The credit of this undertaking is due especially to Hon. George H. French, Major George P. McClelland and Mr. Nicholas Kuhnen.

Mrs. Putnam attended the meeting in Minneapolis of the American Association for the Advancement of Science in August, 1883, renewing and forming friendships with Eastern scientists and interesting them in the Academy. Professor F. W. Putnam visited Davenport from Minneapolis and gave a lecture for the benefit of the Academy. The visit of Professor W. H. Holmes at

this time was followed by an offer to write a paper on the pottery contained in the Academy museum, the Smithsonian Institution to furnish the plates to illustrate the paper. This is the most valuable paper ever printed by the Academy on the pottery in its collections. The generous offer was gladly accepted, so Volume IV was started with the sum of only $72.37 on hand, and unpaid subscriptions amounting to $51.

Entertainments helped to meet the expenses of the Academy. Courses of lectures were successfully given; the annual children's entertainments on the twenty-second of February were never by any chance omitted; an extensive exhibition of English water colors proved a great success both artistically and financially. All these undertakings and many others, of which space will not permit the mention, testify to constant, busy work on the part of Mrs. Putnam. There were hours of grief which were silently hidden from her immediate family, but which a stray letter reveals. She laments writing a sad letter the day before, to her sister, "but how can I help it; now and then I feel I must cry out in agony, but to-day I determined to work, work again for the beloved Academy, and so I get me to work."

In 1885 a salary of $500 was voted for Mr. Pratt as Curator. He had given all his spare hours, from the beginning of the formation of the museum, to arranging the specimens, and had been a most faithful worker. All the work in the Academy previous to this time had been verily "a labor of love." As usual Mrs. Putnam raised the money, assisted in part by Mr. E. P. Lynch.

June 9, 1885, Mrs. Putnam writes: "The Horticultural Society offered the Academy strawberries and cream for a festival. I have all the management and responsibility. I rather shrink from it, quite different from a few years ago when such a thing was fun; especially as I have all of the profits for my publication. Mr. Holmes' paper is done, and I have to pay out $100 right away and have not one cent." After the entertainment was over, on June 22, she writes: "I have given a most successful and brilliant Academy festival—a decided success—a large crowd of people —superb music and strawberries (150 quarts were given me, all the cream, flowers, etc.). I took in $70; some necessary expenses took my profits down to $60. As I had to meet a bill of $144, it helped me that much and encouraged me to attempt another."

The Davenport Chapters of the Agassiz Association were formed about this time. Mrs. Putnam was naturally much interested in their meetings at the Academy and often attended them, reading to them from "Walks Around My Garden" and other books. They frequently spent the day at "Woodlawn." Mrs. Putnam always wanted the children to come to the Academy. She writes: "The lot was given on the twenty-second of February; the building dedicated on the next twenty-second; children entertained the next, and every year this has been our 'Saint's Day.' We expect 500 children" [at the entertainment she was planning]. In the summer of 1886 the National Convention of the Agassiz Association had a most successful meeting in Davenport; over one hundred delegates were entertained.

April 2, 1886, she writes: "Printers do go so slow [all of Vol. IV not finished]. Yet I have commenced another, Vol. V, and have eight pages printed; but a gentleman has given us such a splendid paper to be fully illustrated, and so many of our members subscribed at once, that I am not going to have the same trouble with Vol. V. It is just splendid, too, that our publication goes straight on. As soon as one volume is done another begins, and once in three years we bring out our latest thought. Vol. IV is making for us a splendid record—so I think one thousand more books will come into our library this year. Two thousand came last year. We have to-day received a beautiful collection of shells and minerals. I attended a meeting for birds this afternoon. It is dreadful, the slaughter of the innocents. I visited seven ladies, all of whom promised to take them off their hats. Fifty ladies signed a paper for the same." Never afterwards would Mrs. Putnam wear aigrette or wing in her bonnet.

There always was need for money, and on July 13, 1886, another lawn fête was given for the benefit of the Academy, at "Woodlawn." Mrs. Putnam writes on June 14th: "It will be about nine years since my last "Kettledrum," and that is still remembered by everyone. Great changes have occurred in my home since then. . . . When I think of all I have lost in these nine years my heart shrinks from the effort, but it must be done. I must work to live; the Academy must have money, and who will give it to us? So I am bound to go through with it. This "Mid-Summer's Night's Fête," as it was called, was successful in every way.

Mrs. Putnam was most modest about her own abilities. On October 17, 1886, she writes: "I was much interested in your account of the robins. I am sorry I have not studied the habits of birds and animals as I would have done had I been a woman of leisure. But the fitting of these young lives to cope with the world, the impressing their natures with the love of truth, and forming their characters for noble aims, has been the engrossing work of my life, and the little I have done for the scientific world is to oil the wheels of this institution by getting money to carry out the scientific thought of my beloved son Duncan and his associates. His monument he builded himself. God grant it may grow more worthy of his noble life and as years roll on take the hold of the people his sacrifices entitle it to."

It was felt that there should be some permanent basis to pay the salary of the curator, besides a yearly subscription and the dues of the members, so Mrs. Putnam reported to the Board of Trustees, on November 25, 1886, a plan to "raise an annual subscription of $400 a year—for five years—to provide for the support of the Academy and obviate repeated appeals to the public." This plan received, according to the Proceedings, "the approbation of the Trustees," and Mrs. Putnam was appointed to raise the amount.

The old subscription paper is still preserved, the worn edges testifying to the faithful service it did as it made its yearly rounds. The mute signatures tell little of the part they played in tiding the Academy over the most critical part of its history. Many of the early enthusiastic members had died; there was little interest felt in the institution by the majority of citizens. No one knows the number of times Mrs. Putnam was advised to close the doors and simply let it die. The subscription paper stands a monument to her indomitable perseverance and courage.

Of the efforts to raise this money Mrs. Putnam writes to her husband on December 10, 1886: . . . "Oh, that I could know some of the mysterious joys of a true scientist and a true artist, but I don't believe it was meant I should classify or arrange anything unless maybe a subscription paper; this I have done of late to my great satisfaction and have more than one-half of what I expected pledged for the coming year of the Academy. . . and then if they sign for five years they may some of them remember

us in their wills—anything we give to for five years we love, you know; and if we tide our beloved son's Academy over these five years, as we have the last since he left us, I really think it will be taken care of, don't you?" And again on January 2, 1887, to her sister-in-law, Mrs. Mary P. Bull: "$350 a year has been subscribed without much effort. I shall hope to get at least $400 before another week, but I have been too busy sewing to attend much to other matters. . . . I often wish I were rich. I would never see that boy's institution suffer for the want of so little; but it will be endowed some day; and his name will live as it ought to live when marble monuments have perished and monumental fortunes have crumbled away. The memory of my beloved Duncan will live for ever in the hearts of all who knew and could appreciate his gentle, quiet, and scientific nature. It is five years since we laid him away, but oh! how his presence haunts my dreams, how often I think of him and long for the touch of that vanished hand."

The last $50 of this subscription was raised by Major McClelland for Mrs. Putnam, who was ill at home, but who writes on hearing that the entire sum was raised: "I never felt more happy than to-night for I feel sure now the Academy has a future."

On the morning of June 3, 1887, the beautiful home of "Woodlawn" was destroyed by fire. None of the family were at home. Mrs. Putnam was in Chicago. It was decided to camp out for the summer in the gardener's cottage on the hill. Both Mr. and Mrs. Putnam took up the readjustment of their household in the changed surroundings, with their usual quiet courage, Mrs. Putnam making a cosy home with the few things saved from the fire. She lamented the loss of the drawings and writings of her son Duncan, and of Mr. Putnam's unpublished literary papers, the work of a lifetime, but she felt that as long as the family circle remained unbroken, there was a bright side to the disaster. This comfort was soon taken away, as six weeks later, on July 19, 1887, her husband, Charles E. Putnam, died after a short illness.

Mr. Putnam was a man of strong personality. He had been a prominent lawyer, President of the Davenport Savings Bank for fourteen years and had written the Savings Bank Law which was adopted by the State of Iowa, and is still in force. He was

President of the Gas Company, the Plow Company, and of numerous other organizations. He had infinite tact and a wonderfully quick mind that grasped the essentials of a subject at once and enabled him to carry on so many and varied lines of work. He had a strong love for literature and accumulated a large and well selected library. His leisure hours, for years, were spent in literary work. He followed his children's occupations with the same interest as his wife, and through his son Duncan became interested in science. He was President of the Davenport Academy of Sciences in 1885 and 1886, on its finance committee for years, and trustee for fourteen years. He was a man of broad sympathies, and every good work received support from him. Much of the work that Mrs. Putnam accomplished is due, no doubt, to the encouragement and sympathy she received at home.

Their married life of thirty-three years had been so congenial and ideal that his death would have been a deep sorrow at any time, but especially so after the loss of their home and with the uncertainties of the future. After a few weeks the widow, left with six sons and one daughter, roused herself from her grief and writes to her sister: "The work of life must go on; these dear children must be helped to maturity. I have made up my mind to go to town each day and do my duty for my children." In the fall of this year the family moved to a house in town, where Mrs. Putnam lived the remainder of her life.

The next winter she interested herself to see that the salary of Mr. Pratt, the faithful curator, was paid.

Mrs. Putnam and her daughter sailed for Europe October 3, 1889. On the morning she left Davenport, Dr. C. C. Parry, ever a staunch friend of the publication, brought the last sheets of the Proceedings, still wet with the printer's ink, to the train, where other members of the Academy gathered. It was the last time many of the old friends met.

The trip abroad was prolonged beyond the original plan on account of Mrs. Putnam's poor health. She took an intense interest in everything abroad, especially the customs and life of the people. She had painted in her younger days, and always had an instinctive taste for the best in art. The galleries were a constant source of pleasure to her. She visited the museums, and was delighted when she found the Proceedings of the Academy

in the libraries. She had a great gift of attracting people to her and everywhere made warm friends. She was the most delightful of travelling companions, and could relate her experiences in a lively, vivacious manner. She was rarely gifted as a conversationalist. As a friend remarked, they would hear something interesting when Mrs. Putnam returned, not of the trivial discomforts of the journey.

This was her longest trip away from home. From girlhood she had been a frequent traveller, enjoying the opportunity to see things and even more to meet people. But she never forgot the interests of home. Mrs. Putnam writes from Paris, in May, 1891, just before sailing for home: "The more I see of this life abroad the more I am convinced the true life is at home and the greatest glory of a woman is to grace her own fireside." As soon as she arrived in New York she writes: "Home! oh, you never can know what that word means to one unless you have been away so long. All America seems home to me—now I have touched my native land, I am perfectly happy."

She missed many old friends upon her return to Davenport. Dr. C. C. Parry, who had been closely associated with her son, Duncan, had died; Mr. Pratt had removed to Minneapolis, where he died two years later. Dr. Barris, one of the few of the old members left, had been appointed curator.

Mrs. Putnam was just in time to start a new five years' subscription paper. On December 18, 1891, she writes to Mr. Pratt: "I have taken up the role of presenting the $400 list to my friends in behalf of the beloved Academy—shall I call it a success? In about three weeks I have $300 on the five years' subscription, from 1892 to 1896, and $60 on this year . . . but I shall have to wait a little while until I recover from a refusal from ——— and a very few poor men like him! It will do me good to wait and consider, it was such easy sailing. People met me more than half way. I own up I went first to the old and tried friends of the Academy. . . . We owed the curator $300 when I came home; by January first I think we can almost pay last year's salary, but oh, we must get enough to keep him next year, and next, and next, for five years, and then the $120 for the Index—we must have that, you see . . . and then the binding and distributing! will we wait forever for the endowment! . . . I wish I could do something in

my small way to make the annual meeting a worthy meeting, worthy the spirit of the past. What an interest we used to feel, what palpitations of the heart lest all the reports should not be up to the standard. What a full life we are leading, and how little we know it."

Four times did Mrs. Putnam secure this assured income to the Academy; the last time in 1902, the year of her death. This was for a larger amount, eight hundred dollars; and by this means the Academy was enabled to secure the whole time of a curator, and started on its new era of prosperity. Once when a friend had spoken to Mrs. Putnam about leaving something to the Academy, she wrote: "I wish he would just give it now and spend it himself." She was ever eager to see immediate results.

On November 23, 1892, there is a letter to "My dear friend Mr. Pratt: Do you remember the long ago—when the spirit of unrest drove me to make a commotion in the dear old Academy building, and desks and cases were moved, and decorations were hung—a piano brought in, and flying feet did the work of busier brains, and all was commotion for one day or two and disorder for a week or so afterwards, at least you and Duncan used to declare you could find nothing. . . . Well, I have been strongly reminded the last month of these dear old commotions and upsettings, yet with many differences. Then the object was always to make some money—now it is alone to spend it; then the movement and stir was witnessed by loving eyes who followed in sad disapproval, with a lurking smile of satisfaction at the known results; now no loving eye has followed—no helping hand has lifted itself—no laughing, warning voice has been uplifted that this must be the *very last* entertainment in the Academy. Alas, the last gatherings there have been funerals, and the stillness of the grave has followed my lonely steps as I have plodded along. . . I have only touched on the outside of it all [in the cleaning]. I feel as though I had lived over twenty years in this month. . . I have put Prof. Starr's paper in the printer's hands Monday of this week — made the same bargain as for Vol. V; and while there is not a cent to begin paying the printer, I have faith that by the time the first form is printed the money will be forthcoming."

This cleaning was preparatory to the celebration of the twenty-

fifth anniversary of the founding of the Academy. The day before, on December 13, 1892, Mrs. Putnam writes, "I'm so sorry I undertook the Academy entertainment just now, but a twenty-fifth anniversary does not often occur. The weather is beastly, yet I have to go out in it for the last things. Think of us to-morrow." That afternoon Mrs. Putnam was injured in a fall from a street car and was unable to go to the entertainment. A few days later she writes, "I love the Academy better to-day than when my dying boy almost breathed its name with 'Mother' from his parting breath—it was his legacy to me. When I thought I was killed the other day I was glad that the Academy had a new coat of paint on it. . . My back troubles me some. I think almost more than at first. Yet I go out every day and try to think I am not hurt."

At this time Mrs. Walworth, one of the founders of the Daughters of the American Revolution, induced Mrs. Putnam to become the first State Regent of Iowa.

In 1895 Mrs. Putnam was left a bequest by her sister-in-law, Mrs. Mary Putnam Bull of Tarrytown, New York, of the sum of ten thousand dollars, "as a memorial to my brother, Charles E. Putnam, and my nephew, J. Duncan Putnam." It was Mrs. Bull's idea to have part of it used in erecting a monument in the cemetery. Mrs. Putnam placed a large glacial boulder, found on the banks of the Mississippi, to mark the resting place of these two men of simple tastes. The inheritance tax of the State of New York was five hundred dollars and Mrs. Putnam gave the remainder, nine thousand five hundred dollars, to the Academy, establishing the Putnam Memorial Fund, the income to be used toward carrying on the publications of the Academy. No more fitting memorial could be found in view of the long and intimate association of father and son with the Academy.

Previous to this time the publication had had a struggle for existence. The six volumes published prior to 1895 had cost over eight thousand dollars and this entire sum had been raised by three- and five-dollar subscriptions to the volumes, obtained by repeated solicitation by Mrs. Putnam. A very few, like Prof. Sheldon, gave generously. Sometimes the money came so unexpectedly that Mrs. Putnam was wont to say "it sifted down from heaven." When publishing Vol. IV, she writes, "I find people

now understand what publishing proceedings means and are interested at once and willing to help. I have met with great success, without begging in the least. The publication now stands on its own merits."

Mrs. Putnam spent the summer of 1897 in Europe with two of her children, travelling leisurely from Norway to Italy.

On December 11, 1897, Mrs. Putnam writes of celebrating the thirtieth anniversary of the Academy on the 14th, "by a simple reception at Academy afternoon and evening. For days I have cleaned up things. I hope to close this year with every bill settled and all dues collected. The contract for the new [Presbyterian] church was let yesterday. They have offered the old building to me for the Academy for $5,000,—a great bargain, I think." Four years before, on September 10, 1893, there is mention in a letter of Mrs. Putnam's of the importance of the Academy owning the property on the corner, when the Presbyterian Church removed to other quarters, as they would eventually do.

She never lost sight of this project, and patiently and persistently worked till she persuaded the trustees to see it from her point of view. The Academy owned land on the north for future building purposes, and many thought the old church building would only be an incubus. A few far-sighted trustees realized it was a good investment at least. It has proved a most wise one. There is a hall for lectures and a high basement to contain part of the ever increasing museum. If the Academy had not bought it a large apartment building would have been erected, cutting off light and sunshine from the Museum. It preserves for the Academy one of the most commanding corners in Davenport. The Trustees of the church most generously placed a much lower price on the property than they could have obtained from other parties. On April 3, 1898, Mrs. Putnam writes: "Mr. Cutter says the Jewish Synagogue came to ask the price and wanted to buy the church, but when they heard Mrs. Putnam wanted it for the Academy, they would not make an offer." The Trustees of the Academy bought the church property in 1899.

On December 3, 1899, after the close of the last service held by the Presbyterian church in the building, Dr. Donaldson stepped from the pulpit and handed the key to Mrs. Putnam, then the

oldest living member of the church, who received it on behalf of the Academy. Upon taking the key she said: "No words of mine can adequately express my feelings in accepting the key of this old church, which so many hallowed associations have endeared to me, or of the gratification I feel in knowing my interest in it is not entirely to cease, as this key will pass into the custody of the Davenport Academy of Natural Sciences, an institution which, next my family and my church, holds the dearest place in my heart."

The purchase of the old church entailed an enormous amount of work. The first problem was how to pay for it. Mrs. Putnam was aided in raising the money by the Hon. C. A. Ficke. It was decided to connect the two buildings by a passage way, large enough to be used for museum purposes. Mr. E. S. Hammatt and Mr. A. F. Cutter superintended the construction, while that of cleaning and arranging the two buildings was done by Mrs. Putnam. Griswold College was disbanded at this time, and Bishop Morrison and the trustees of the college generously gave its valuable scientific collection and library to the Academy. With this added space, the Academy could exhibit the collection at once. The work of moving the collection was very great. Mr. C. E. Harrison attended to the transporting and sorting of the books, but for weeks Mrs. Putnam was busy superintending the transfer and arrangement of the collection. All this made the summer a busy one. Mrs. Putnam secured the services of a trained librarian, who began the arrangement and cataloguing of the library, disturbing the dust of years. It was realized as never before what a rare and valuable library the Academy possessed. During all the years that the publication of the Academy proceedings had been going on, laboriously but perseveringly, the library had been steadily growing. Foreign societies had been sending their publications in exchange, thus proving the foresight of those members who inaugurated the printing of original scientific papers by the Academy.

The start made in cataloguing the library has been kept up by Miss Foote-Sheldon, so that now the large collection of books is available for use by scientific students.

On the thirty-third anniversary of the founding of the Academy, December 14, 1900, Science Hall, the new lecture room, was

dedicated. President MacLean and Prof. C. C. Nutting of the State University of Iowa, came from Iowa City, and Prof. Frederick Starr, from the University of Chicago, gave a lecture. Letters from scientific friends all over the country were read, congratulating the Academy on the work achieved during its existence of a third of a century.

As one of the tributes, Prof. Nutting read the following poem:

THE STORY OF TWO WOMEN.

There was a woman on whose heart was pressed the heavy hand of Sorrow.
Her heart was bruised, her head was bowed, her life bereft of hope and light.
This woman was not strong, and so she sat her down and cried:
"Woe has come upon me, and my love lies dead, his work unfinished.
No more is heard his name upon the lips of men. With him is Hope entombed.
Henceforth my life shall be devoid of light, and o'er his grave I'll place
A broken shaft to show the incompleteness of his life cut short of full fruition."

And so it was. Her life was void. His name forgotten in the homes of men.

Again there was a woman on whose heart was pressed the heavy hand of Sorrow.
Her heart was sore, her head bowed low, her life bereft of light.
But strong this woman was, and brave, and she stood up amid the stress
Of this her dire calamity, and gazed undaunted on the face of Sorrow.
"My love shall live!" she said. "His work unfinished I take up. My life I give
To see his hope fulfilled. His name shall still be spoken in the courts
Of Wisdom, and a monument I'll raise to show fruition of his cherished hopes."

And so it was. And wise men came to bring her aid. And lo! Her life was full
Of light and blessed with fruitful works. No broken shaft raised she
Above his tomb. Instead she reared a monument enduring as is Truth eternal.
And the wise men bring their tribute of their learning to this shrine.
His name is honored still in Wisdom's court. His work complete. His hope fulfilled,
And Sorrow, conquered, chastened, owns the sway of Love.

Soon after Mrs. Putnam's return in May, 1901, from California, where she had spent several months for the benefit of her health,

occurred the death of Dr. Barris, an early member, ex-President, and curator of the Academy. He had ever been a faithful friend to Mrs. Putnam, one who encouraged her by his hopeful conversation and charming personality to go on with her work. The death of Dr. Barris left but two out of the group of the early active members: Dr. C. H. Preston, who has been a member of the Publication Committee from its inception and who has ever taken a deep interest in the affairs of the Academy, and Mr. C. E. Harrison, who has given generously of his time and energy to further its success, working with the same loyal interest during the years of discouragement as during those of prosperity. As the office of curator was now vacant, and as the five years' subscription paper expired at this time, some of the most prominent citizens again advocated the closing of the Academy. Instead, Mrs. Putnam arranged to have the present curator of the Academy, Mr. J. H. Paarmann, then a student at the University of Iowa, come to Davenport and remount, classify, and label the fine collection of birds in the museum.

In August of this year Mrs. Putnam, accompanied by her daughter, attended the meeting of the American Association for the Advancement of Science, at Denver. Later, at Glenwood Springs, Colorado, she met with a serious carriage accident which nearly proved fatal, and from the effects of which she never entirely recovered. As she lay helpless, being unable to move for weeks after her return, her mind was full of plans for the "beloved Academy." Among other things she arranged for a course of popular scientific lectures, which was successfully given after Christmas. This was the beginning of the courses which have since become an annual feature of the Academy's work.

In the meantime, how to provide for and find a curator? No sooner was Mrs. Putnam able to move than with painful but unflinching steps she visited the faithful patrons of the Academy and raised the sum of eight hundred dollars for five years, double the amount raised in previous years. In April, 1902, Mr. J. H. Paarmann was appointed Curator, upon which office he entered the following July. He began, in the fall, a series of talks to the school children, illustrated by specimens from the Academy's collections. This was a project in which Mrs. Putnam had always taken deep interest.

After this work was started Mrs. Putnam and her daughter spent several months in California. A letter written to her brother, Mr. J. Duncan, from Del Monte, March 25, 1902, tells of her nervousness in driving (a natural sequence to her terrible accident a few months previously), and of her success in conquering this feeling: "We took the seventeen-mile drive along the Pacific. I never enjoyed a drive more in my life and I think it was because I had entirely mastered myself and my fear of mountain drives. I thought it all over in the night and when the carriage came round, with five seats beside the driver's, and the rest were all ready, I quietly put on my things and astonished them all by taking my seat in the exact position I sat in when the accident occurred last September. One place, where the road ascended a very steep place and turned on top and came down a very abrupt descent, I thought I would get out and wait; but I had started out to conquer, and so I sat still. I must say I drew a long breath when we reached the bottom, but I was master of myself and that is what I long to be above every other thing."

The summer was spent at home, where Mrs. Putnam took up her work for the Academy with her old enthusiasm, taking great interest in the labors of Mr. Paarmann in his new office as Curator. In August she arranged for a successful concert, given by the musicians of Davenport for the benefit of the Academy.

Mrs. Putnam, accompanied by her daughter, attended the meeting of the Americanists in New York in October of this year. She enjoyed meeting old friends and making new ones, listening to scientific papers; but, on looking back, one realizes that while the spirit was as eager to enjoy and impart, the body was growing weaker. The journey was continued to Boston, where she met many old friends, and revived memories of her visits there with her son Duncan. It was her last journey.

Mrs. Putnam was elected a fellow of the American Association for the Advancement of Science, at the December meeting, 1902, in Washington. This unexpected honor greatly pleased her, though she felt herself undeserving it. But, as one of her scientific friends has said, "to whom could it have been more worthily given than to her who had striven so loyally for the advancement of science?"

The Academy was in urgent need of a stereopticon, to use in

the talks Mr. Paarmann gave to the school children; and on January 3, 1903, Mrs. Putnam writes: "Every day I receive money (as the sparks fly out of the fire at me) for the stereopticon. I have written a short report for the annual meeting. We have $148 in the bank and not a bill to pay, left from last year." On February 14, through gifts of generous friends, she succeeded in paying $1,000 on a note against the Academy. It was a happy morning for her, as she realized the Academy was now on a better financial basis, besides beginning active educational work.

An exhibition of Indian basketry, planned and managed by Mrs. Putnam, was opened at the Academy on the nineteenth of February. A much larger collection of baskets had been gathered than was expected, and the building was effectively decorated with mats, blankets, and examples of weaving. On the second day of the exhibition, Friday, February 20, 1903, Mrs. Putnam was the life of the company. Some one suggested having a loan exhibition of lace: and her quick mind seized the idea, and with her old-time enthusiasm, in bidding a friend goodby, she said, "You must come next month to our lace exhibit."

Mrs. Putnam returned home at twilight and, sitting before the open fire, talked of the events of the afternoon, of the meeting with old friends; that it was the most beautiful exhibition ever given in Davenport; what a pleasure the day had been. She went to her room to rest. A Final Rest it was. Painlessly and silently she passed into the World Beyond—a world in which she firmly believed she was to meet her beloved family and the son for whose sake she labored so faithfully in the upbuilding of the Academy.

With kindly thought of friends and with her last hours spent in the institution that had become an integral part of her life, the day was a beautiful closing to a full and unselfish life.

A few days later Science Hall, the old Presbyterian church, which had been so intimately connected with Mrs. Putnam's life, was filled with family friends and citizens, gathered for the simple but impressive funeral exercises. Rev. Dr. John B. Donaldson of the First Presbyterian Church, her pastor, and the Rt. Rev. T. N. Morrison, Bishop of Iowa, an old family friend, conducted the services. Mrs. Putnam was broad-minded in religion as in all the affairs of life, so it seemed fitting that the last services for

her should be conducted by clergymen of different denominations, as had been the case with her husband and eldest son.

Mrs. Putnam was survived by six sons—Charles Morgan, of Minneapolis; Henry St. Clair, a consulting electrical engineer in New York; William Clement, a lawyer in Davenport; George Rockwell, in charge of the United States Coast Survey work in the Philippine Islands; Edward Kirby, in the English Department in Leland Stanford Junior University, California; Benjamin Risley, a mining engineer in Butte, Montana, and by one daughter, Elizabeth Duncan.

Her children having already been provided for, Mrs. Putnam left her entire estate to establish a Putnam Memorial Fund for the benefit of the Davenport Academy of Sciences, subject to an annuity which was waived by her daughter, Elizabeth Duncan Putnam, and to certain other obligations which were assumed by her son, William Clement Putnam. By the terms of her will this fund, amounting in all to about twenty-four thousand dollars, is to be held in trust for the Academy by a board of three trustees and the income is to be used primarily for the publication of scientific papers.

Emphasis has been placed upon Mrs. Putnam's connection with the Academy of Sciences, of which she was President in 1879 and again from 1900 until the time of her death, Treasurer from 1897 to 1900, and Chairman of the Publication Committee from 1881 to 1903. There is a remarkable human interest in Mrs. Putnam's work for the Academy, growing as it did out of her love for her oldest child. To quote the words of a friend: "We all remember vividly the noble and beautiful mother of that large family, who yet found time out of the devotion to her children and her abounding hospitality to magnetize a careless western community and inspire them to rear an institution devoted to pure science. She began the work for the sake of her son. Young as he was, Duncan Putnam had done work of recognized value the world over; and he did the best of it conscious of his sentence of death, but working doggedly with his last strength. To comfort him his mother threw all her splendid vitality and energy into his plans."

But absorbing and exacting as was this interest in the Academy, it by no means measured the breadth of her sympathies and activity. Another friend writes of her: "Because she gave

so much of herself to the Academy did not mean she had less to give to other things; on the other hand, her love for that institution seemed to increase her endowment, to broaden and enrich her spirit, so that other things profited rather than lost thereby. Her great purpose did not cause her to lose her sense of values. Indeed, the charm of her personality was in its many-sidedness. Her love of the beautiful in nature and art, her keen interest in people, and her inspiring belief in them,—all of these things seemed to be stimulated rather than stifled by her great enthusiasm."

In this many-sided life the key-note was always the home. The first duty of every woman, Mrs. Putnam felt, was to her family. From the days when she was a boon companion to her "blue-eyed banditti," as she called her children, entering into all their sports, even to the setting of type, to the days when they had grown to manhood, each varied occupation and experience of theirs received her sympathy and enthusiastic interest.

In her country home Mrs. Putnam delighted to have friends come and share the simple every-day life of the family. It was ever a joy to her to do kind actions. It required no special effort, because it was perfectly natural.

Mrs. Putnam always found time to be interested in the aims and work of others. A chance remark of hers would leave an indelible impression. Many an incident has come to light showing the influence a word or two spoken by her had on the course of a young life.

Sincere indeed was Mrs. Putnam's interest in those causes that touch the human heart. Instances of this have already been mentioned. She was always active in church work and, while seldom talking about religion, lived her christianity in everyday life. She was for several years president of the Home Missionary Society of the Presbytery. She was a charter member of the Ladies' Aid Society to educate young girls, of the Associated Charities of Davenport, and of other similar organizations. She was largely instrumental in bringing a police matron to Davenport. When it was decided to close all the stores in the city at six o'clock in the evening so that the clerks would not be overworked, it was Mrs. Putnam who persuaded the last obdurate owners to sign the agreement. It was this sincere and sympa-

thetic interest in humanity, as well as her personal interest in all whom she knew, even though casually, that made her hosts of friends and endeared her to the people of her home city and to all who came to know her. A friend writes: "No one woman stood for all that she did in the community, the sympathizer with every good work, the originator of many, the presiding genius of the Academy, and, what made this vital and enduring, a rarely beautiful Christian character."

Out of the crowded memories of the past comes a vision of a woman of medium height, clear blue eyes; a well-poised head, crowned with beautiful silver-white hair; an alert, light step; a vivacious manner and quick intellect that may have come from some far away Huguenot ancestor; a voice of unusually sweet and gentle modulation, the whole personality lighted by a smile full of sympathy and enjoyment of life.

Sorrow had written its history on her face, but it was illumined when she talked or listened to others. Although endowed with a rare social instinct and delighting in the contact with her fellows, she was a great lover of nature. Many a sunrise and sunset she watched in Europe, the dawn coming upon the Jungfrau, or the marvellous afterglow at sunset,—a symbol of the resurrection, as she expressed it. Many of her letters from "Woodlawn" are dated "at sunrise." The quiet communing with nature and reading one of the beloved Psalms of David gave her the peace and strength to plan her work for the day, and with a refreshing sleep afterwards she arose bright and sunny as the morning itself. She was one of the most natural of women, perfectly unconscious of self. What people might think of her simply never occurred to her. What they thought of her children or of the Academy was another matter.

Mrs. Putnam's early life, fatherless and with an invalid mother, had developed a naturally forceful character. A happy marriage brought out all the sweeter, unselfish qualities of her nature. She writes, early in her life, "God formed me with a heart so large that even a husband's and children's love does not fill it full to overflowing." She could always enter into the trials and sorrows of others with an unusual sympathy. She was ever a friend to the poor, treating them with a rare equality. The accident of riches was nothing to her,—"A man 's a man for a' that." If

people were dull and selfish, though they might have all the world's goods, they were perfectly uninteresting to her. Gossip and unkind remarks were never heard from Mrs. Putnam. She felt that there were so many interesting things in the world to talk about, why waste time in matters worse than trivial. She often quoted the saying "Blessed is the man or woman with a hobby," feeling that the interest in outside affairs broadened the home life and, when sorrows came, enabled a person to rise above them, in work for others. As a friend said, "She was a woman who was not afraid to live up to her convictions." This fearless, unselfish character was what enabled her to go on with the work of the Academy, when a weaker woman would have been discouraged at the difficulties and would have counted the cost and personal sacrifice.

With her earnest purpose and unselfish devotion, Mrs. Putnam was enabled in her well-rounded life of three score and ten years to crystalize her high ideals into permanent results. She was of a most hopeful, cheerful disposition, and while she remembered the past and while it influenced strongly her life, she lived in the present, planning for the future.

Her children arise up and call her blessed.

Give her of the fruit of her hands; and let her own works praise her in the gates.

DAVENPORT, IOWA, December 14, 1905.

WILLIAM CLEMENT PUTNAM

A MEMOIR

WILLIAM CLEMENT PUTNAM

A MEMOIR

BY ELIZABETH DUNCAN PUTNAM

On the western banks of the Mississippi, on the bluffs overlooking the broad river, lies the town of Davenport, in Iowa. The scene is one of quiet beauty, with the river winding onward, peacefully and majestically, amid the encircling hills. Here was born on the twenty-sixth day of June, 1862, William Clement Putnam, the fifth son of Charles Edwin Putnam and Mary Louisa Duncan, his wife.

Brief was his life as the years are told, but into his forty-three years he crowded the work and achievement of a long life. The same traits of foresight, courage, energy and perseverence that had sent his ancestors from their homes in Massachusetts and Virginia to develop new lands, kept him in his native city and enabled him to build up a fortune and leave it for the benefit of Davenport. Descended on his father's side from New England families, men and women who led industrious, simple lives, and on the mother's side from Scotch and Virginians, into whose lives had come much of interesting adventure and history, his own character shows a combination of the traits of both families.

The incidents of Mr. Putnam's life were few. He lived and died in his native city. The first twenty-five years were spent at Woodlawn, a beautiful country place overlooking the Mississippi, about two miles from the center of Davenport. The family life of father, mother, ten sons and one daughter has been graphically portrayed in the letters of his mother, who did much to encourage the children to follow their individual tastes.

Especially strong and decided, even in childhood, were the characteristics of Mr. Putnam. It is interesting, in reading his

early letters, to see indications of the traits of later years. The boy of nine writes to his father, "Now, about the money question," and upon receiving the remittance, thanks him and adds, "I hope I shall not spend it foolishly." His early interest in politics is shown by a letter written a month later to his father, in which he begins, "Hurrah for Grant;" and upon hearing of his father's politics he writes, "I am sorry you like Horace Greeley so much."

Surrounded by his father's large and well selected library and brought up in "a reading family," it was only natural that his latent love for books and knowledge should develop early in life. For many years, by rising early in the morning and retiring late at night, he accomplished an enormous amount of systematic reading of the standard authors. He had a retentive memory, especially for facts and information, and during these years of boyhood amassed a store of knowledge from which he drew at will in later life.

His oldest brother, Duncan, was, at this time, collecting insects and carrying on his scientific work. He took great interest in the occupations of his younger brothers and it is no doubt largely through his influence and through the constant encouragement of his father and mother that Clement Putnam began his collections and interest in outside affairs. An historical society was organized among the brothers at Woodlawn and papers were read at the meetings. Clement Putnam was the dominant and persevering member that carried the society through its existence.

Very early he began to collect material for local history. This interest was developed by a visit to his mother's former home, Jacksonville, Illinois. He met many old friends of his grandfather, Governor Duncan, and gained from them an impetus to his interest in historical subjects. He planned at this time, when only eleven years old, to write a biography of his grandfather. Unfortunately he did not carry out his boyish plan, though he never lost sight of it. He constantly collected material and facts and looked forward to the time when he would have an opportunity to write. When sixteen, he was interviewing old settlers and buying books about the Black Hawk War. His letters show his exact and intimate knowledge of where old books could be bought and of their relative value.

When a copy of Wakefield's "History of the War Between the United States and the Sac and Fox Nations of Indians" was loaned him, he writes on November 26th, 1878: "I was too much interested in the other book [Wakefield's History] to think about it [Cunningham's Lives] at first. I could scarcely believe my eyes when I saw what book it was, for I knew it was Wakefield's book instantly although the title page is gone. I have every other book of importance upon the Black Hawk War except this one and I never expected to have this one in my possession even for a short time, as it is one of the rarest western books ever published, besides being of great value in itself . . . It is to me the most precious relic of a bygone age . . . Before returning it I would first like to make some extracts from it concerning those things which are of the greatest interest to me, though I am afraid I would never know where to stop, so much am I interested in everything of which it treats." He copied the entire book.

Again on January 13th, 1885, he writes: "I have always had a great passion for old papers and autographs and have already a large and valuable collection. As soon as my collection of grandfather's papers is complete I intend to arrange them and have them bound in volumes."

With his love of collecting came a strong ambition to write. At the age of ten he had written a tragedy of five acts which was acted on an amateur stage at Woodlawn. This was followed by plans for various works in history, but unfortunately his busy life did not enable him to accomplish all he hoped.

Mr. Putnam was educated at the public schools in Davenport and was graduated from the High School in 1880. When but eleven he had decided upon becoming a lawyer. He was ambitious to go first to college, but feeling that his father needed his help, he laid aside this dream and entered the law office of Putnam and Rogers. This prompt and decisive response of the boy to what he felt was a call of duty was characteristic of the man. One wonders what the effect of a university education would have been upon his mind, so eager and enthusiastic for knowledge. He himself always regretted the loss. He spent two years in his father's law office before going to Iowa City to attend the law school of the State University of Iowa, from which he

was graduated in 1883. He was chosen one of the orators of his class, his subject being, "The State." He assisted Chancellor McClain in preparing his "Outlines of Criminal Law and Procedure," published in 1883. He selected cases and "showed a rare judgment for a law student in his first year of study." Soon after his return his father took him into partnership, the firm name being Putnam and Putnam. The next few years were spent in close application to business and devotion to duty.

On the third of June, 1887, the house at Woodlawn was destroyed by fire. All of Mr. Putnam's historical books, manuscripts and valuable collection of old letters relating to western history were burned. It was an irreparable loss. The death of his father, six weeks later, left the family in peculiarly sad and desolate circumstances and added new responsibilities to his life. He assumed the care of managing the affairs of his mother and brothers and sister, becoming the virtual head of the family. Nobly did he perform this duty. He arranged the finances so that his younger brothers received a college or technical education, and sold the old homestead to such advantage that his mother was placed in comfortable circumstances. In the autumn of this year the family moved into town. Mr. Putnam soon after bought the house in which they first lived and took great interest in improving the property and making it a family home. Into this house he gathered his constantly growing collection of books and works of art. He was an intense lover of home and enjoyed having his family with him, but unselfishly urged his mother and sister's taking an extensive European trip in 1889, and numerous other journeys.

Charles E. Putnam had numerous business interests besides his law practice. Clement Putnam succeeded his father as president in many of these organizations. Often the young man of twenty-five, who looked much younger than his years, presided at a meeting of gray-haired men, contemporaries of his father.

Charles E. Putnam had been agent for the property in Davenport belonging to Charles Velie of Evansville, Indiana. This consisted of a half block of buildings forming the old LeClaire, later the Newcomb, Block, in the center of the business district of Davenport. Clement Putnam assumed the management of it during his father's lifetime and later Mr. Velie, one of many of the loyal clients of his father, continued him in charge of his in-

terests. Thus he became familiar with it and when the opportunity offered, in 1895, to purchase the property, he realized its value and bought it. It is this property, with its large rental, that becomes the chief source of the income of his bequest to the Davenport Academy of Sciences. The improvement and care of these buildings gradually absorbed most of his time. From a financial standpoint it was most advantageous. Mr. Putnam had marked business ability, as is shown by his acquisition, in his short life, of a large fortune. His business interests, however, prevented him from becoming the distinguished lawyer that the few briefs and opinions he wrote indicate he might have been with the ability he possessed. He had a clear mind and forceful power of expression, and enjoyed the discussion of legal questions. Chancellor McClain, now Judge of the Supreme Court of Iowa, writes of him: "I regarded Mr. Putnam as having a mature and sound legal mind and urged him to undertake some legal writing, but he seemed too busy for it although it was in accordance with his tastes."

Business affairs necessitated frequent visits to New York and gave him, incidentally, an opportunity to come into closer touch with the literary and artistic world. Unconsciously these visits broadened his outlook on life. He was now able to buy the rare and beautiful books he had always loved. Even when his income was small, the few books he bought were chosen with care and he was beginning to plan and develop in his mind the scope of his future library. He took infinite pains in the selection of any book or picture, and his perseverance was remarkable. For years he was on the lookout for Wakefield's "History of the War," and at last, in 1902, he was rewarded and became the possessor of the little old yellow book that had aroused his enthusiasm as a boy.

He became interested in fine publications and illustrations and gradually collected a rare library on architecture, music and painting, besides general literature and history. Librarians have expressed interest in his library on account of its extent and range. Though guarding his books with zealous care, he was ever willing to loan them to any one studying a special subject, aiding them also by his own extensive knowledge.

After buying a few etchings in 1898 in New York, he became

interested in the subject and in time came to own a valuable collection of works by the best known etchers, besides almost every book on etching. He mastered the literature and technical criticism of the subject in the same thorough manner as he mastered everything he undertook.

Mr. Putnam commenced early in life to buy paintings, chiefly small good examples of modern artists. He writes on June 9th, 1891, "I want to add to my collection of paintings every year, laying the foundations for the Art Gallery I intend to have in my Castle in Spain when I build it." His art gallery was a dream unfulfilled for himself, but by the provisions of his will it will become a reality for the town he loved.

Mr. Putnam always looked forward to a time of leisure in which he could do the writing he planned. His extensive knowledge of western history, with his accurate mode of thought and expression, makes it a matter of deep regret that the only historical writing preserved is a short paper on "Davenport and Vicinity in the War of 1812," written in 1877, and read before the historical section of the Davenport Academy of Sciences. He wrote a memoir of his father, Charles E. Putnam, in 1898, published in Proceedings of the Academy, and three papers for the Contemporary Club, composed of the leading business and professional men of Davenport. The titles of the papers show the trend of his thought toward some of the questions of the day:

1898. "Some Problems of Modern Democracy."

1902. "Civic Beauty."

1905. "International Arbitration and the Peace Movement."

He possessed a clear, forceful style and a good command of the English language.

As the years went on, his interest in public affairs steadily increased. No question came up affecting the public welfare of Davenport but he took a deep interest in it and went to considerable personal sacrifice to achieve the end in view if it was for the betterment of the city. Never did his faith waver in the future of Davenport. He had high ideals and believed in planning and building for the future. The great fault, he felt, of the average citizen, was in letting franchises or laws pass unnoticed if they did not happen to affect his personal interest or pocketbook. It was only a very few who ever troubled themselves to

protest or be on the lookout for the best interests of the city. He himself took a deep interest in municipal affairs, especially in the city's parks and public institutions. Referring to the park system of Boston, Mr. Putnam writes: "Every one of us should lay the lesson of that noble work to our hearts and do what we can to make the city of our home the better and the more beautiful for our having lived in it."

There are copies of frequent letters written by Mr. Putnam to our United States senator about public affairs, especially protesting against the tariff on works of art. He felt that America needed all the art and beauty that could be imported to counteract our commercial spirit. When urged to help in the endowment of an eastern institution, he replied that whatever he did for art would be done in his native town. Here he hoped there might be a gallery, small but with a few choice paintings. In 1898 he was interested in selecting pictures and bas reliefs to decorate the two upper rooms in the grammar school attended by many members of the family. In 1905 he gave a full-sized frieze of Donatello's "Children" to the Public Library for the children's room. He also loaned them his carefully selected collection of a hundred large Braun photographs of the most famous paintings by artists of all countries and ages, framed and labeled.

Mr. Putnam was seldom away from Davenport. A boyhood journey to the Centennial, various business trips and one European tour complete the record of his journeys. His life is an example of steady application to business and shows how, with few opportunities of travel, can come the love of the best in art, music and literature. His only trip abroad was in 1903 when for seven months he travelled, with his sister, through the principal cities and countries of Europe. In looking back one realizes the reason of his intense enthusiasm and desire to see places of interest. For years he had worked perseveringly and read extensively and now when his holiday came he enjoyed it with the zest of a boy. Europe was never visited by a more appreciative or intelligent visitor. His familiarity with history, his love of architecture, painting and sculpture, his interest in people, customs, and the different institutions of the countries made the trip a memorable one. He considered this the beginning of many journeys. It was his only one.

From his early interest in the Historical section, Mr. Putnam became more interested in the Davenport Academy of Sciences. The untiring work for this institution of his brother Duncan, devotedly supported by his father and mother, all tended to influence a man of such loyal character as his to take up the work as one by one they laid it down. There was a deep and peculiar attachment between Clement Putnam and his mother, and it was for her sake especially he did so much for the Davenport Academy of Sciences. Even as a student at the law school he writes, urging that the affairs of the Academy be established on "a sound financial basis." After the death of his father he succeeded to his position of looking after the finances of the Academy, a position to which there were no rival claimants. When the treasury was empty Mr. Putnam, like his father, advanced the money to pay the bills, ever anxious that the credit of the Academy should stand unimpaired.

During the years from 1876 to 1880 he took a keen interest in the Historical Section of the Academy. He felt that the study of local history and the collection in its archives of local historical material should be an important feature of the Academy work. In his report as secretary of the Historical Section, on January 7th, 1880, he speaks of the gift of the papers of Antoine LeClaire, "many of them of the greatest value and importance in illustrating the early history of this region, and quite a number of old French papers of great interest. It is out of such material as this that the historian weaves his interesting narrative, and the value of these old manuscript collections cannot be too deeply appreciated. There have been deposited, in the library of the Section, files of New York papers published during the late war, and twenty-two volumes of the Davenport *Gazette* from its commencement. Next in order to collections of manuscripts, newspaper files are of great utility as historical material. But by far the most important work of this past year was the series of meetings of the old settlers of this county, held during the spring and summer at the Academy. As a result of these meetings and of circulars sent among the pioneer settlers still living, a large number of letters giving interesting narratives of early days have been sent to the president of the Section; others have been promised, and when the whole series has been completed it will form a store-

house filled with information which must otherwise have been lost."

Mr. Putnam was Trustee of the Academy from 1887 to his death, and was on the finance committee for fifteen years. His last act was to dictate the report of the finance committee for the annual meeting, announcing that after strenuous efforts the Academy was free from debt, and adding, "this is probably the first time since the founding of the Academy, nearly forty years ago, that this could be said, so we feel that the Academy is to be congratulated on its splendid financial condition; but people must remember that this is only a means of accomplishing still greater ends in the future, in developing the internal work of the Academy, in providing new cases and apparatus and assisting in the important work of the Academy in the schools." This report was dictated with difficulty and pain. Loyal was he even on his deathbed to the trust he felt his mother had left to him. His bequest to the Davenport Academy of Sciences crowns his mother's life work for this institution.

In the midst of enjoyment and activity in the present and plans for the future came his first and last illness. His strong will had kept him at work too long. There were only a few days of illness, serious from the first, with a rally to dictate his reports and give directions to donate a large collection of old and rare Arizona baskets to the Academy. His death came on the morning of January thirteenth, 1906.

Mr. Putnam was a man of strong personality. He combined the thoroughness and faculty of taking infinite pains with the greatest persistence and pleasure in overcoming all obstacles. Once started upon a subject, his determination never let him rest until he had mastered it thoroughly. In many traits he reminded one strongly of his mother. He had a great desire to acquire information from other people, and possessed the power of assimilation, so that anything once acquired was always useful. He had keen judgment and appreciation of literature, art and music. One might differ from him, but he was ever interesting. He was fearless in speech. He was generous and ready to aid in all good causes and help with counsel and personal interest in the affairs of any worthy person. He combined a great amount of sentiment, which he tried to conceal, with the clear-headed views of a

business man and lawyer. Those who knew him in his own home, surrounded by his books and pictures and talking with congenial friends, felt to the full the charm and power of Mr. Putnam.

His life, though unfinished, was more complete than many a a longer one. Wisely and clearly he laid his plans for the future. Devoted to his family, home and city, he left his fortune, subject to annuities to his brothers and sister, and his collection of art, historical and scientific books, besides his paintings and sculpture, to trustees as an endowment for the Davenport Academy of Sciences, for the benefit of "the citizens of this community wherein my father and mother so long lived and labored for the public weal."

WILL OF MARY LOUISA DUNCAN PUTNAM

By the will of Mary Louisa Duncan Putnam her estate, subject to an annuity which was waived by her daughter, Elizabeth Duncan Putnam, and to certain other obligations which were assumed by her son, William Clement Putnam, is left to three trustees for the benefit of the Davenport Academy of Sciences. The trust, designated as the "Putnam Memorial Fund," is founded as a memorial to her husband, Charles Edwin Putnam, and her son Joseph Duncan Putnam.

By the terms of the trust William Clement Putnam is named as legal trustee during his life, his successors to be chosen by her surviving children, approved by the court, and, after the death of all the children, directly by the judge of the court. With him are to be associated two other trustees: one, her daughter, Elizabeth Duncan Putnam, and after her decease, one person to be chosen by the members of the Publication Committee of the Davenport Academy of Sciences, and the other, a person to be chosen by the Board of Trustees of the Academy, both of the last trustees, when so chosen, to be for a period of three years. The trustees of the trust fund are to make an annual report to the trustees of the Academy. The trustees shall use the net income from this trust fund as follows: Not to exceed ten (10) per cent in any one year may be used for the "care and preservation of, and additions to, the collection of entomological specimens and books made by my said son, Joseph Duncan Putnam, and now in the building of the said Academy." The balance of the income shall be used "for the publication and distribution of the papers and transactions of said Academy, which shall be of scientific, or ethnological, and (on special occasions if deemed desirable) of historical value and interest, and assist in the diffusion of knowledge, it being my desire generally that at least one paper in each volume published be upon some entomological subject." It is further provided that the trustees may use a portion of the income of the fund, not to exceed one-fourth in any one year,

"toward the payment of the salary of a curator of said Academy, if such use of a portion of said income in their opinion becomes necessary to properly maintain the work of said Academy. But I earnestly hope that the said Academy may in the near future receive a sufficiently large endowment from public-spirited citizens, or others, to enable it to properly carry on its great work aside from its publications, leaving the income from this trust fund to be used solely for the purpose for which the trust has been founded."

WILL OF WILLIAM CLEMENT PUTNAM

In his will William Clement Putnam left his entire estate in trust for the benefit of the Davenport Academy of Sciences, naming as trustees of the fund thus created his brothers, Henry St. Clair Putnam, George Rockwell Putnam, Edward Kirby Putnam, Benjamin Risley Putnam, and his sister, Elizabeth Duncan Putnam. He provides first for the settlement of his estate and the preservation of his business and other property.

The homestead, with the personal property contained therein, is given to his sister during her life. After her decease the homestead is to revert to the estate, to be merged in the trust fund and the personal property is to be divided among relatives, "excepting however that when such distribution of my personal effects is made, either upon written notice from my said sister to my said Executors and Trustees, or the survivors of them, during her lifetime, or in any event upon her decease, I give and bequeath all my art, historical and scientific books, together with all my oil and water color paintings, etchings, engravings, drawings, sculpture and other works of art, to the Davenport Academy of Sciences of Davenport, Iowa, to be kept in a fire-proof art gallery in one of its buildings to be built as hereinafter provided, and I further direct that, after the completion of such fire-proof art gallery, my collection of English water colors shall be placed therein, as soon as possible, to prevent the risk of their destruction by fire, even before title thereto may pass pursuant to the above provisions. The gift of the foregoing books and works of art to the said Davenport Academy of Sciences is made upon the express condition that none of said books, pictures and other works of art, shall ever be sold or disposed of by said Academy or its successors."

Annuities are designated to be paid to his four brothers and sister in lieu of their compensation as executors and trustees, and provision is made for the rebuilding, with modern and fire-proof construction, of the buildings upon his business property. The fifth paragraph of the will then provides for the Academy as follows: "The balance remaining each year from the net income of all my

estate as aforesaid, I direct my said Executors and Trustees, or the survivors of them, to pay to the Trustees of the Putnam Memorial Fund of the Davenport Academy of Sciences, of the City of Davenport, Iowa, said Trustee and Board of Trustees being the ones designated in the Last Will and Testament of my mother, Mary L. D. Putnam, now deceased, such payments of income to be made as often as my said Executors and Trustees, or their survivors, may think best, but at least annually, and all of said balance of the net income arising from my estate to be used for the benefit of the said Davenport Academy of Sciences, or its successors, or otherwise, upon the terms and under the conditions in the Seventh paragraph of this Will particularly set forth."

The seventh paragraph of the will provides for the permanent maintenance of the trust fund and its use for the benefit of the Academy of Sciences:

"Seventh. Subject to the foregoing provisions of this Will, and as a memorial to my beloved parents, Charles Edwin Putnam, and Mary Louisa Duncan Putnam, deceased, I give, devise, and bequeath all of my estate, real, personal, and mixed, and wherever situated, upon the decease of the last survivor of my brothers and sister hereinbefore named, to the Trustee, and Board of Trustees, of the Putnam Memorial Fund, and to his and their successor or successors in trust forever, as the same are designated in the duly probated last will and testament of my mother, Mary L. D. Putnam, deceased, and as the same may be from time to time hereafter appointed, elected, and qualified, as is in my mother's said will provided, said property and estate to be held in the same manner in all respects as is in my mother's said will directed, for the benefit of the Davenport Academy of Sciences, of Davenport, Iowa, or its successors, and the income therefrom arising, together with the residuary income from my estate prior to the decease of all my brothers and sister hereinbefore named as provided in the Fifth paragraph of this Will, to be used for the following purposes only, to-wit: *First.* In the payment of all taxes, insurance, repairs, improvements, and all other expenses and charges of whatever nature or description which may be from time to time required in the proper management and care of said trust estate, and in the proper maintenance in first-class

condition of all property and assets belonging to said trust estate. *Second*. In the rebuilding of any of the buildings upon any of the real estate belonging to said trust fund whenever such rebuilding may become necessary in order to properly maintain or increase the value of such real estate. *Third*. In the erection of new buildings for, or additions to the present buildings of, the said Davenport Academy of Sciences, it being my earnest desire, however, that such building fund be allowed to accumulate until it reaches at least Fifty Thousand ($50,000.00) Dollars, and is in any event large enough to permit the erection of a thoroughly satisfactory, handsome, and fire-proof structure, which will be in the highest degree creditable and useful to the said Academy, and to the City and State in which it is located, and which shall contain, in addition to fire-proof museum rooms, a fire-proof art gallery for the proper exhibition and preservation of works of art which shall be of genuine value and merit only. *Fourth*. After providing as large as possible a sinking fund each year for the erection of said building or buildings of the said Davenport Academy of Sciences, or after providing for the payment of any additional obligations incurred in the erection of such buildings, the remainder of said net income may be used each year, so far as necessary, for the general support and maintenance of the said Davenport Academy of Sciences, or its successor; and after the erection of such building or buildings the whole of said income may be used if desired towards the care and maintenance of said building, museum, art gallery, and library, the support of the curator and other employees, the prosecution of the work of the Academy, the purchase of additions to its museum, library, and art gallery, and the publication of its proceedings, and of papers of scientific, or historical, value and interest, until it shall again become necessary to erect another new building for the said Davenport Academy of Sciences, when such portion as may be deemed advisable of the net income from said trust estate shall again be used towards the establishment of another building sinking fund. In the event that the said Davenport Academy of Sciences shall ever cease to exist, and shall have no successors in the City of Davenport, then and in that event I direct that the Trustees of the said Putnam Memorial Fund, to

be chosen in such case by the court having probate jurisdiction in the City of Davenport, Iowa, as provided in the last will of Mary L. D. Putnam, deceased, shall proceed to execute and carry out the purposes and intents of the trusts in this will provided, as hereinbefore expressed, as nearly as may be, and, if necessary, to found some other institution in the said City of Davenport which shall as effectually and usefully as possible accomplish such purposes and intents, or similar ones which shall be of beneficent use to the citizens of this community wherein my father and mother so long lived and labored for the public weal."

List of Fishes Collected at Hong Kong by Captain William Finch, with Description of Five New Species

BY DAVID STARR JORDAN AND ALVIN SEALE

IN the summer of 1900, in connection with the explorations of Japan made by Professors David Starr Jordan and John Otterbein Snyder, a collection of fishes from the market of Hong Kong was obtained by Captain William Finch, commander of the steamer Gaelic of the Pacific Mail Steamship Company. This collection was sent to the museum of Stanford University, a series of duplicates being placed in the United States National Museum. As the fauna of no part of the world is less exactly known than that of China, it is worth while to place this list on record. The following species seem to be new:

Sphyræna putnamiæ	No. 9063 Stanford University.
Caranx altissimus	No. 9066
Amia elizabethæ	No. 9064
Pseudosciæna undovittata	No. 9065
Insidiator detrusus	No. 9067

Family CARCHARIIDÆ.

1. *Scoliodon acutus* (Rüppell).

One specimen, length 18 inches, snout about equal to distance from eye to gill opening, pectorals with posterior margin slightly concave, length of base of anal one-half its distance from ventral, teeth entire.

Color grayish, top of caudal dusky.

Family SPHYRNIDÆ.

2. *Sphyrna zygæna* (Linnæus).

One specimen of the common Hammer Head shark. Length 18 inches.

Family NARCOBATIDÆ.

3. *Narcine timlei* (Bloch and Schneider). (Plate 1).

Disk almost round, the two dorsals about equal, hind margin of caudal rounded, united with lower; no fringes on spiracles, which are immediately behind eye.

Color, in spirits, light brown; the upper surface with large, round, brown spots larger than interspaces; ventral surface white.

Two specimens. Length 7–7.20 inches.

Family DASYATIDÆ.

4. *Dasyatis zugei* (Müller and Henle).

Snout rather long-acuminate, pointed at tip, the margins nearly straight. Width of disk slightly greater than its length; length of disk 1.75 in the long whip-like tail; a prominent fold or membrane on upper and lower side of tail; upper surface of the disk smooth (young); eye two in interorbital space; length of eye about equal to the spiracle immediately behind it.

Color, in spirits, uniform light brown above; white below; membrane on tail black.

Two specimens. Length 11–11.50 inches; from Hong Kong.

In overhauling our Japanese material we find nothing which really corresponds to *Dasyatis kuhli*, and the latter species, known by the bluish spots, should be stricken from the list of fishes of Japan. We are not sure that the specimens called *Dasyatis kuhli* from Japan are distinct from *Dasyatis akajei*.

Family DOROSOMATIDÆ.

5. *Konosirus thrissa* (Linnæus).
(*Clupea nasus* Bloch).

Head 4 in length; depth 2.75; eye 3.85; D. 16, the last ray elongate; A. 22, the snout projecting beyond the lower jaw, maxillary extending to below middle of eye; the last dorsal ray elongate, reaching base of caudal.

Color, in spirits, brownish above each row of scales with a line of brown spots, uniform silvery below; a large dusky blotch posterior to upper margin of opercle.

This species is quite distinct from the Japanese species, *Kono-*

sirus punctatus, which species is more elongate, with the upper jaw less prominent.

Three specimens. Length 6–6.25 inches.

There is yet no trustworthy evidence that *Konosirus thrissa* occurs in Japan, or that *Konosirus punctatus* is found in China. *Chatœssus aquosus* Richardson, from Canton, seems to be *K. thrissa*.

Family CLUPEIDÆ.

6. *Ilisha elongata* (Bennett).

Head 4.20 in length; depth 7.50; eye 3.10; adipose eyelid well developed; origin of dorsal midway between tip of snout and base of caudal, anal long, abdomen sharp.

Color, in spirits, silvery white; no dusky markings.

One specimen. Length 16 inches.

Family SYNODONTIDÆ.

7. *Saurida japonica* (Houttuyn).

Saurida argyrophanes (Richardson).
Saurida elongata (Schlegel).

Head 4.50 in length; depth 7.50; eye 6 in head; D. 11; A. 10; scales about 56; snout 4.50 in head; interorbital about equal to snout; adipose eyelid little developed; eye situated on line with middle of lower jaw, a ridge on sides of tail.

Color, in spirits, brownish above with some indistinct blotches, white below; pectorals grayish; caudal grayish-white.

Three specimens. Length 6–6.50 inches.

Family CYPRINIDÆ.

8. *Cyprinus carpio* Linnæus.

Head 3 in length; depth 3; eye 5.50 in head; D. III, 22; A. III, 5, barbels 2; largest dorsal and anal spine serrated behind; scales 30.

Color, in spirits, dusky above; yellowish on lower sides and belly.

Four specimens. Length 7–8 inches.

9. *Ctenopharyngodon idella* (Cuv. and Val.)

Head 3.80 in length; depth 4.75; scales 42, D. 11; A. 10; eye 7; snout 2.85, lips thick, 15 rows of scales before the dorsal, insertion of ventrals on line with origin of dorsal.

Color, in spirits, silvery with slight dusky wash at margin of scales, a bluish wash above.

One specimen. Length 14.50 inches.

Family MONOPTERIDÆ.

10. *Monopterus albus* (Zuieuw).

Head 14.75 in total length.

Color, a drab above, slightly lighter below, with slight indistinct line-marking on under surface.

Three specimens. Length 11–12.50.

Family MURÆNESOCIDÆ.

11. *Murænesox talabon* (Cuvier).

Head 3 in trunk; snout 3.50 in head; mouth, from angle, 1.10 in head; vomerine teeth are conical, straight, wide set, none of them with lobes.

Color, in spirits, grayish, washed with yellowish below, darker above; dorsal with dusky margin.

One specimen. Length 42 inches.

Family MUGILIDÆ.

12. *Mugil cephalus* Linnæus.
(*Mugil œur* Forskål).

Head 3.75; depth 4.15; eye 4.25 in head; D. IV, 8; A. III, 8; scales 39.

Color, in spirits, a light wash of brownish above; silvery below, indistinct dark spot at axil; tip of caudal with a white wash of dusky; fins all white.

Three specimens. Length 5.55–6.50 inches.

This species is identical with the Japanese species. *Mugil œur* (=*cephalotus* =*japonicus*), but as yet no characters separating it from the cosmopolitan *Mugil cephalus* have been pointed out.

Family SPHYRÆNIDÆ.

13. *Sphyræna putnamiæ* Jordan and Seale, new species.

Head (including under jaw) 1.98 in length to base of caudal; depth 7; eye 6.50 in head; D. V, 10; A. 9; scales about 152;

opercle rounded, without a distinct point; preopercle rounded; snout 2 in head; interorbital 3 in snout; opercles and cheeks scaled.

Body elongate, slightly compressed; the head strongly pointed; depth of caudal peduncle 2 in snout; lateral line distinct, 23 series of scales between lateral line and base of dorsal at origin, lower jaw prolonged; mouth large; maxillary reaching to below anterior third of eye; its length 2 in head; teeth in lower jaw in single row, about 10 on each side, directed backward, a single large chisel-like tooth at symphysis; teeth of upper jaw much larger with an outer row of small teeth; six very large teeth on each side in the inner row; origin of dorsal over anterior third of the ventrals; longest dorsal spine 1.50 in snout; origin of soft dorsal equal to distance between base of caudal and origin of first dorsal; origin of anal under anterior third of soft dorsal; base of anal and base of soft dorsal equal 1.70 in snout; caudal emarginate; pectorals short, 1.75 in snout; scales deciduous.

Color, in spirits, yellowish white, grayish on back, a dusky wash on upper part of head; the dorsal fins and tip of caudal with a slight wash of dusky.

Three specimens from Hong Kong, China. Length 7.50–8 inches.

The type is No. 9063 Stanford University, from Hong Kong. Length 7.90 inches.

This species bears some resemblance to the Japanese *Sphyræna japonica* Cuv. and Val., but the scales are much smaller even than in the latter. *Sphyræna chinensis* Lacépède, based on a Chinese drawing, is wholly unrecognizable. The species is named for Mrs. Putnam, the honored patron of the Davenport Academy of Sciences.

Family HOLOCENTRIDÆ.

14. *Holocentrus ruber* (Forskål). (Plate 2).

Head 3 in length; depth 3; eye 2.75; D. XI, 13; A. IV, 9; scales 2–38.

Color, in spirits, yellowish white with several pale red lines on outer edge of caudal; and membrane between last anal spine and first ray dusky, a red blotch just below base of dorsal.

Two specimens. Length 6–7 inches.

These differ from *Holocentrus praslin* Lacépède, a species or subspecies, which replaces *H. ruber*, in the Riukiu Islands and in the South Seas generally, in the much paler coloration, there being no purple-black stripes or markings.

Family TRICHIURIDÆ.

15. *Trichiurus japonicus* Schlegel.

Head 6.25 in length; depth 12.75; D. 1.40; eye 2.50 in snout. Color, in spirits, silvery; dorsal yellowish with dusky outer margin.

Family SCOMBRIDÆ.

16. *Scomberomorus guttatus* (Bloch and Schneider).

Head 4 in length; depth 5; eye 6 in head; D., XVI,–I, 16 IX; A. 1, 20, X; about 12 triangular teeth in each side of upper jaw; maxillary extends to posterior margin of eye.

Color, in spirits, bluish above, silvery below sides; numerous round dusky spots; lobes of dorsal, anal, caudal yellowish.

Three specimens. Length 11 to 12 inches.

Family CARANGIDÆ.

17. *Decapterus russelli* (Rüppell).
(*Caranx maruadsi* Schlegel).

Head 3.50 in length; depth 4; eye 3.10 in head, the adipose eyelid well developed. D. VIII,–I, 29–I; A. II,–I, 27.

Color, in spirits, silvery, slightly brownish above; a distinct opercular spot.

Four specimens. Length about 5 inches.

18. *Caranx kalla* Cuv. and Val.

Head 3.75; depth 2.75 in length to base of caudal; eye 2.50 in head; the posterior adipose eyelid well developed. D. VI, 23; A. II,–I, 20; curved portion of lateral line 1-75 into straight part, the line becoming straight under fourth dorsal ray; 43 armed plates in straight portion; teeth in jaws, vomer, palatines and tongue; no canines; breast scaled.

Color, in spirits, brownish above, silvery with yellowish reflection below, opercular spot distinct; posterior margin of opercles dusky.

One specimen. Length 5 inches.

19. *Caranx altissimus* Jordan and Seale, new species. (Plate 3).

Head 3; depth 1.75 in length to base of caudal; eye 3 in head; no adipose eyelid; snout 2.90 in head; D. VIII, 24; A. II–I, 21; small teeth on jaws, vomer, palatines and tongue, the teeth of jaws in two or more series; no canines; interorbital about one-third less than snout. Body elevated, compressed, the profile evenly rounded, the body very deep; breast naked; the lateral line curved to below posterior third of soft dorsal, the straight portion 1.65 in curve. There are about 35 armed scales in straight portion of lateral line; the scutes not strongly developed; maxillary reaching to below the anterior margin of eye; opercles with notch on upper part; caudal peduncle slim, its length twice its depth; dorsal spines connected, the third spine the longest, 2.75 in head; lobe of soft dorsal 2 in head; anal similar to soft dorsal, its lobe 1.75 in head; ventrals not reaching base of anal, their length 1.75 in head; pectorals 1.10 in head; caudal deeply forked.

Color, in spirits, lower half silvery; upper half with grayish wash; usually four indistinct wide vertical bands of gray on sides; caudal yellowish without dusky margin; ventrals white with a slight wash of dusky at tip, other fins whitish, unmarked; opercular spot very indistinct; a dusky blotch at inner axis of pectorals; a dusky blotch on upper part of eye.

Two specimens from Hong Kong, China. Length 4.75–5 inches.

The type is No. 9066 Stanford University. Length 4.75 inches.

In form this fish somewhat resembles the Japanese *Caranx equula* (Schlegel) but it is deeper and more gibbous on upper profile. The fins in *Caranx equula* have no dark markings.

20. *Caranx atropus* (Bloch and Schneider).

(*Caranx nigripes* Cuv. & Val.)

Head 3.75 in head; depth 1.75; curved portion of lateral line 1.75 in straight part; D. VI–II, 22; A. II,–I, 18; teeth in villiform bands on jaws, vomer, palatines and tongue; breast naked; about 44 armed scales in straight portion of lateral line.

Color, in spirits, brownish above, silvery below; ventrals black, other fins yellowish white.

One specimen from Hong Kong. Length 5 inches.

This species is characterized by the long black ventrals.

Family STROMATEIDÆ.

21. *Stromateoides argenteus* (Bloch).

Head 4.10 in length; depth 1.40; eye 3.75 in head; ventrals none; gill membranes at isthmus united up to a line with lower base of pectorals, lateral line smooth.

Color, in spirits, silvery white, bluish above, yellowish on caudal and caudal peduncle, lobe of dorsal dusky; pectorals yellowish.

One specimen. Length 11 inches.

22. *Apolectus niger* (Bloch).

Head 3.30 in length; depth 1.90; eye 4.75 in head; spinous dorsal obsolete; soft dorsal about 38, A. about 38, no ventrals; pectorals long and falcate, their length greater than head, being 2.18 in length of body, lateral line complete, but slightly curved, and with a few (17–18) slightly developed plates along sides of caudal peduncle; apparently a single row of very small teeth in each jaw, more on vomer or palatine; small scales entirely covering body; lobes of caudal equal.

Color, in spirits, grayish with some slight tints of bluish, some yellowish blotches on head and on lateral rays of caudal; a large, very distinct and sharply defined opercular spot in front of pectoral fin.

One large specimen.

Family EQUULIDÆ.

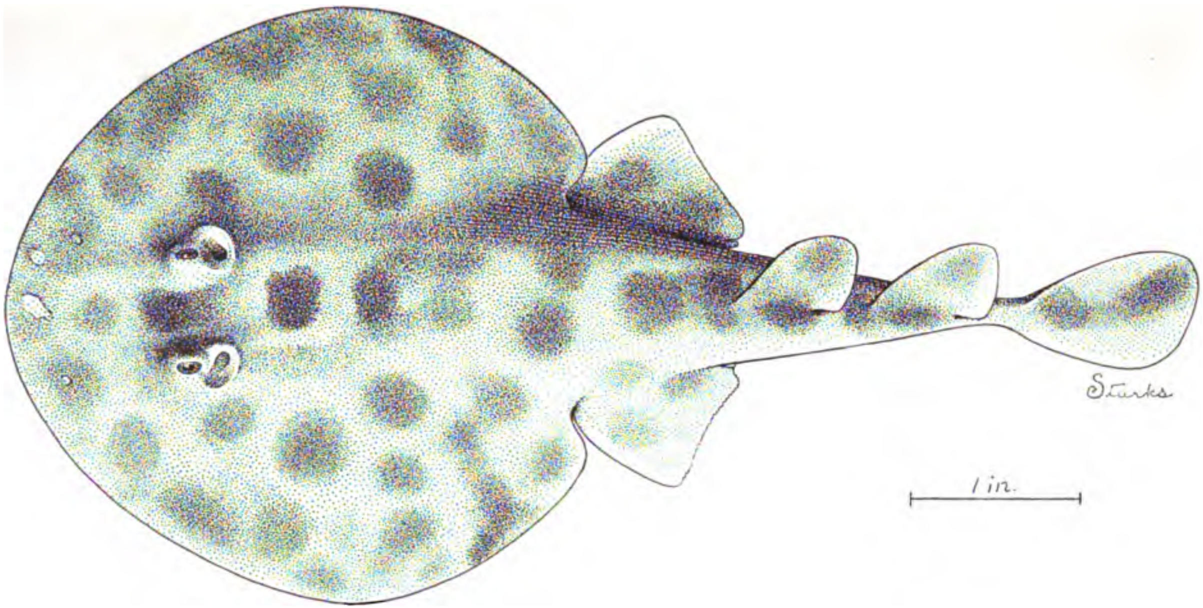
23. *Equula insidiator* (Bloch).

Head 4 in length; depth 2.35; eye 2.50 in head; lateral line incomplete; D. VIII, 16; A. III, 14; breast naked; supraorbital finely serrated, mouth almost vertical.

Color silvery, a black line from lower anterior margin of orbit to chin; back with irregular vertical blackish streaks usually interrupted with spots.

Four specimens. Length about 3.20 inches.

These are similar in most respects to specimens from Manila, although the latter have a little larger eye and a smaller number of bands on the back.



NARCINA TIMLEI (BLOCH AND SCHNEIDER).

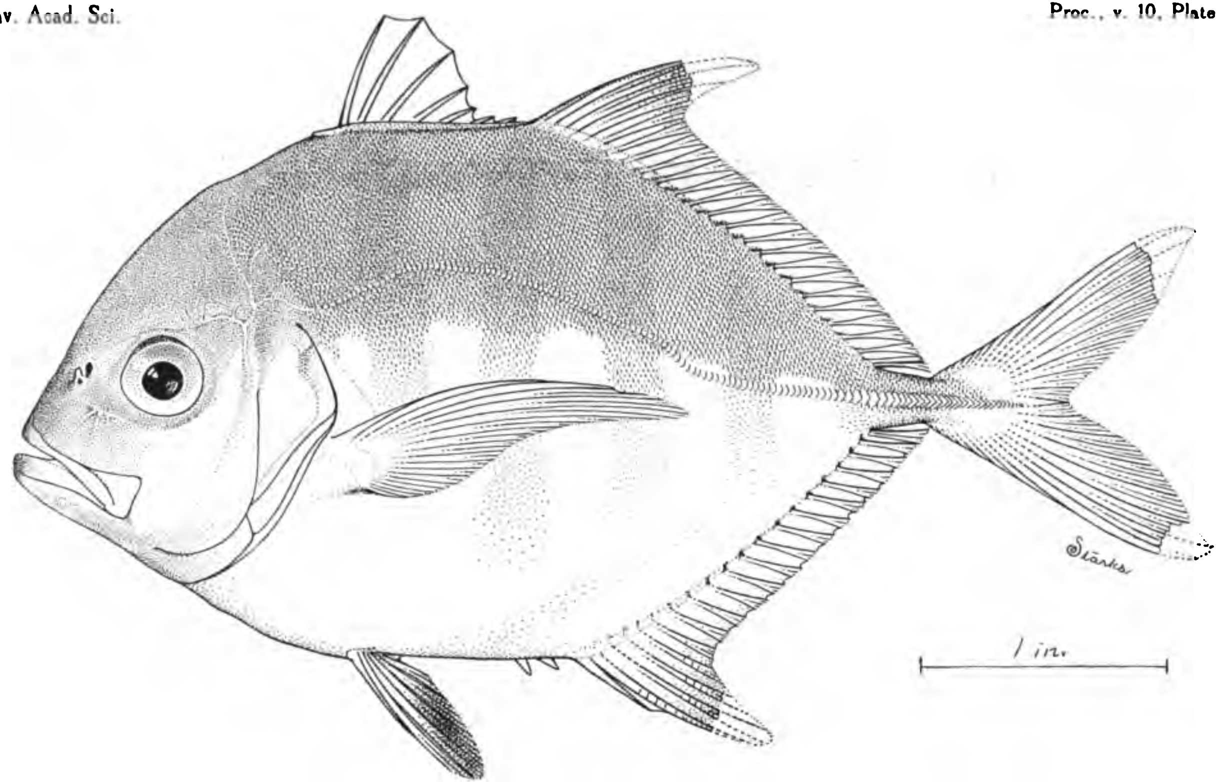
Jordan and Seale – Fishes From Hong Kong.

HOLOCENTRUS

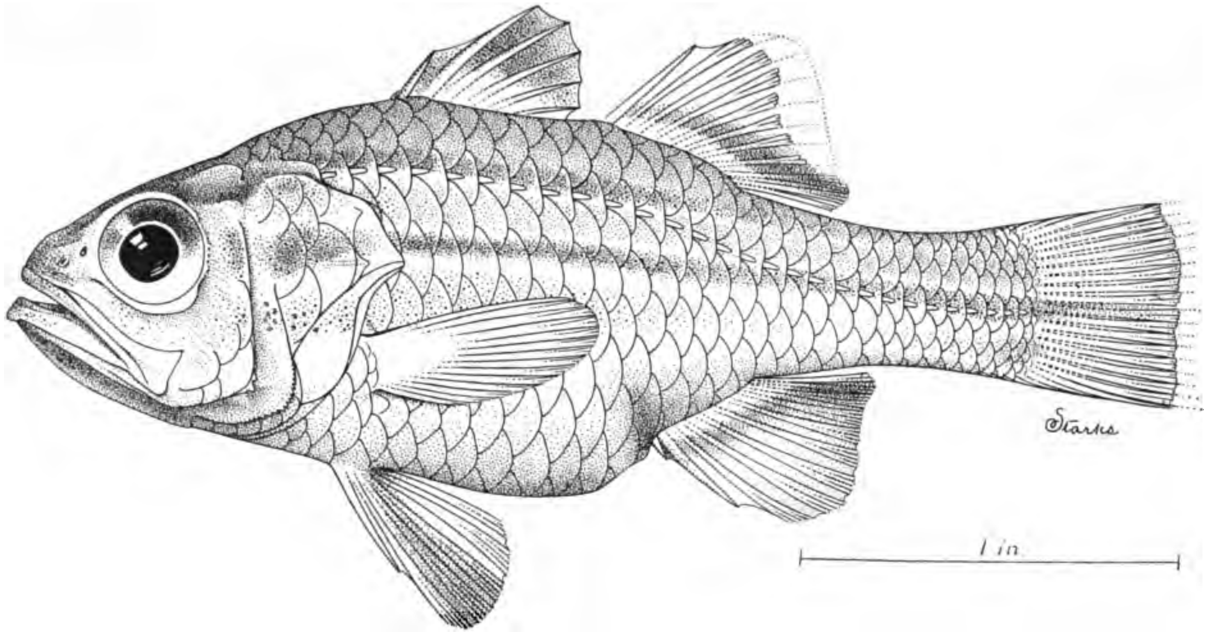
Jordan and Seale—Fishes From Hong Kong
Atkinson, Del.

HELIOTYPE COMPANY, BOSTON

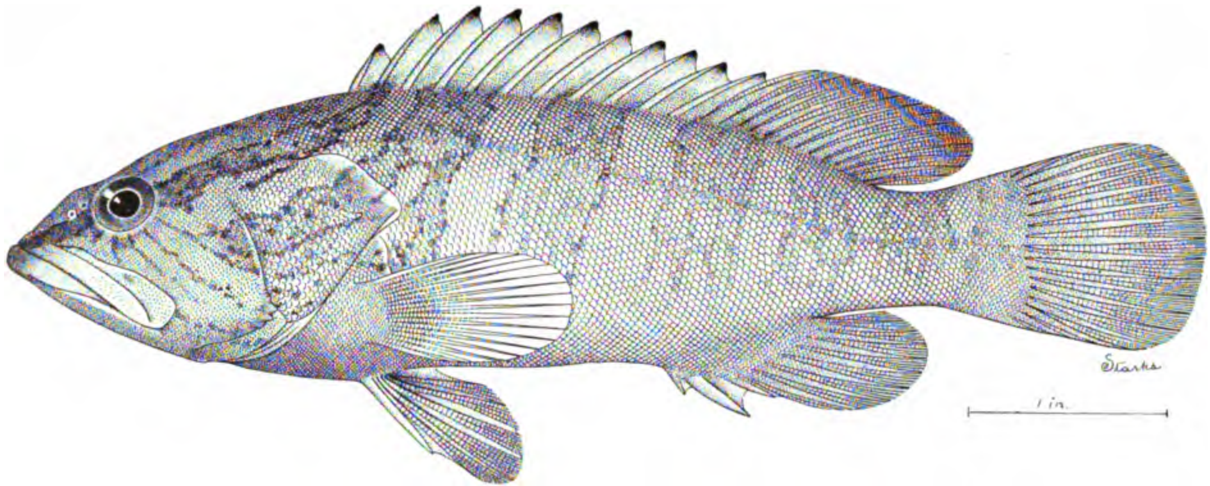
HOLOCENTRUS RUBER (FORSKÅL).



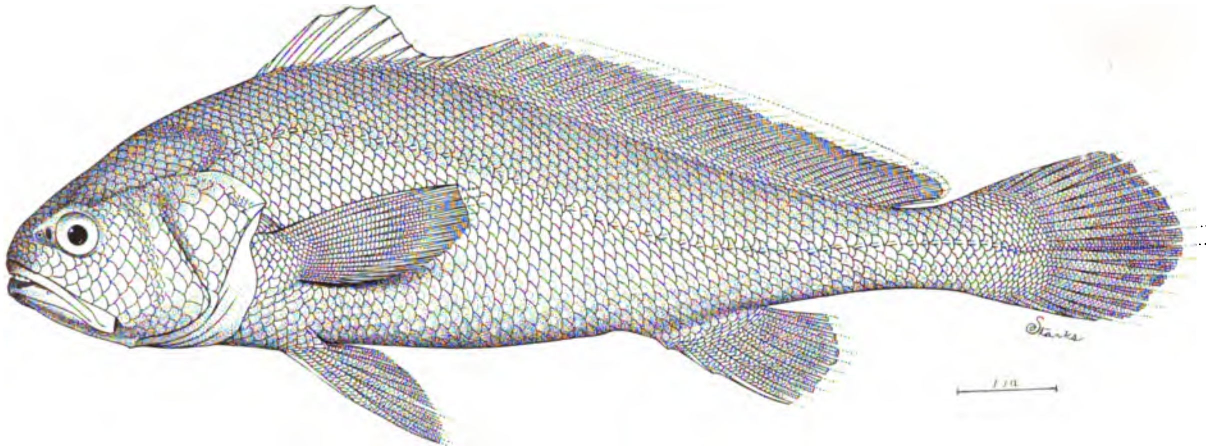
Caranx altissimus Jordan and Seale. Type.



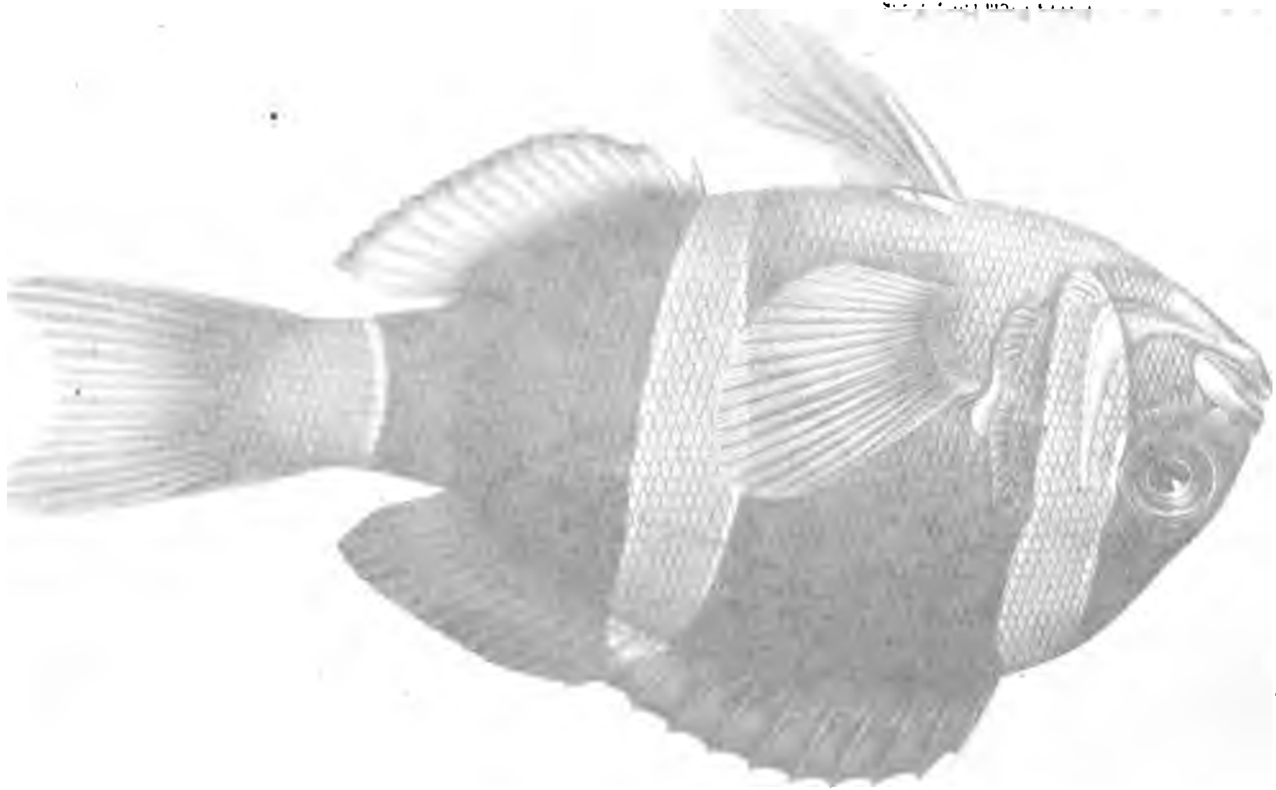
AMIA ELIZABETHÆ JORDAN AND SEALE. TYPE.

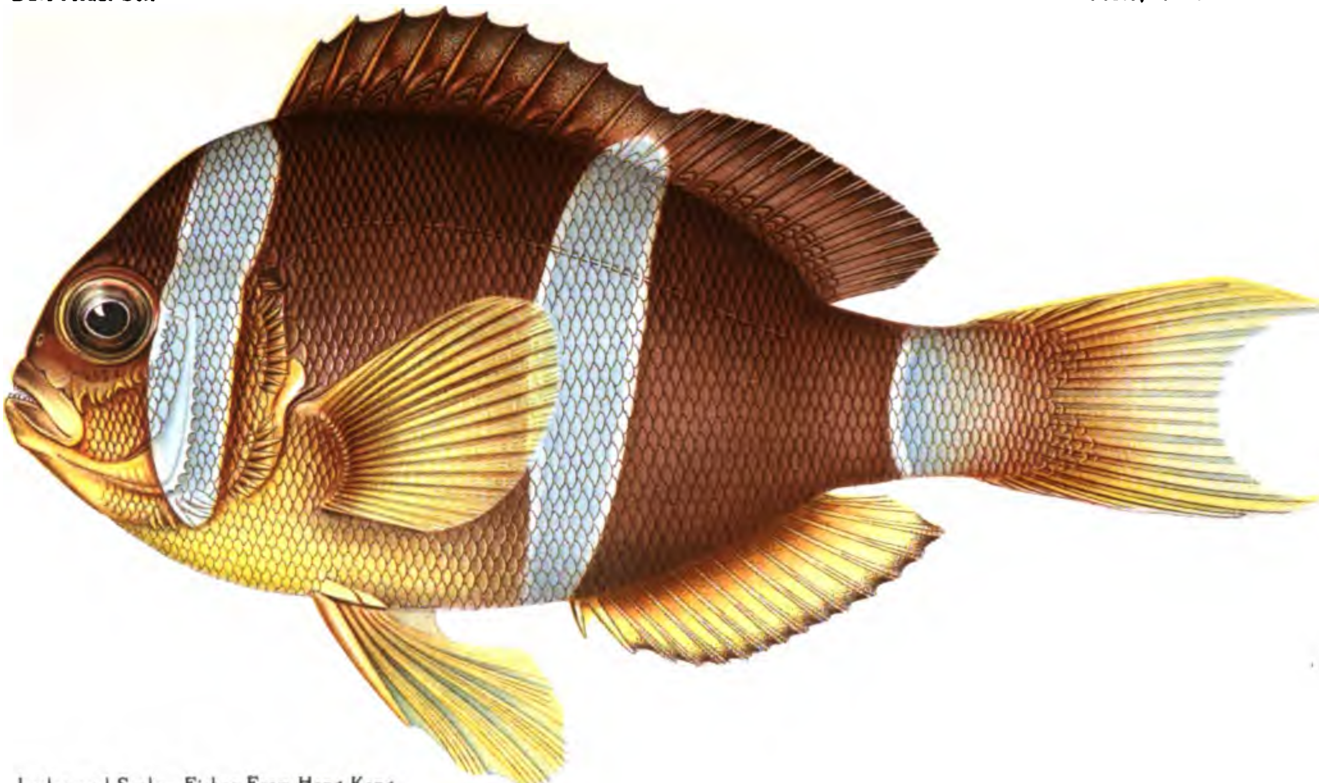


EPINEPHELUS MOARA (SCHLEGEL).



PSEUDOSCIÆNA UNDOVITTATA JORDAN AND SEALE. TYPE.

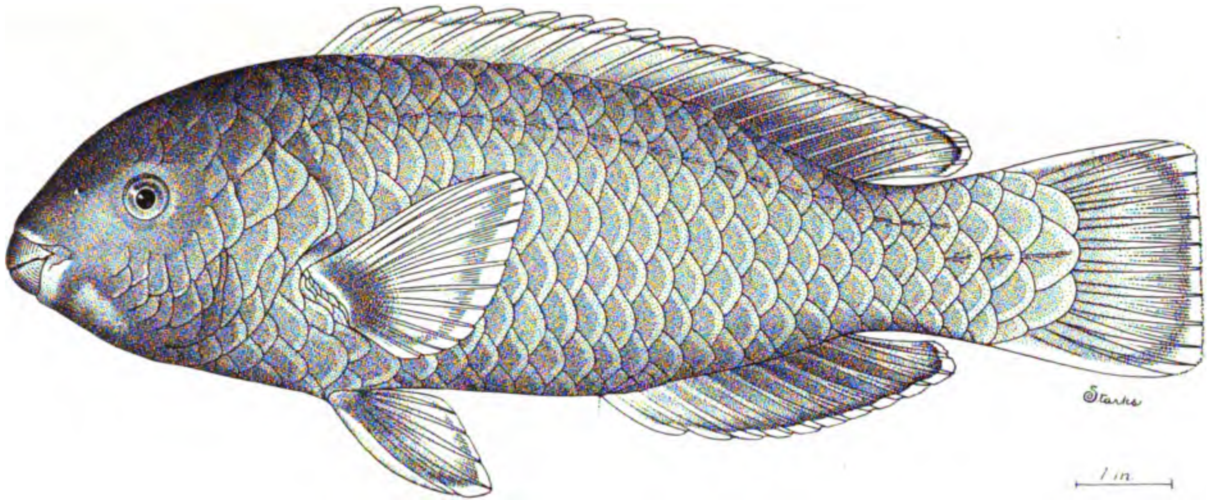




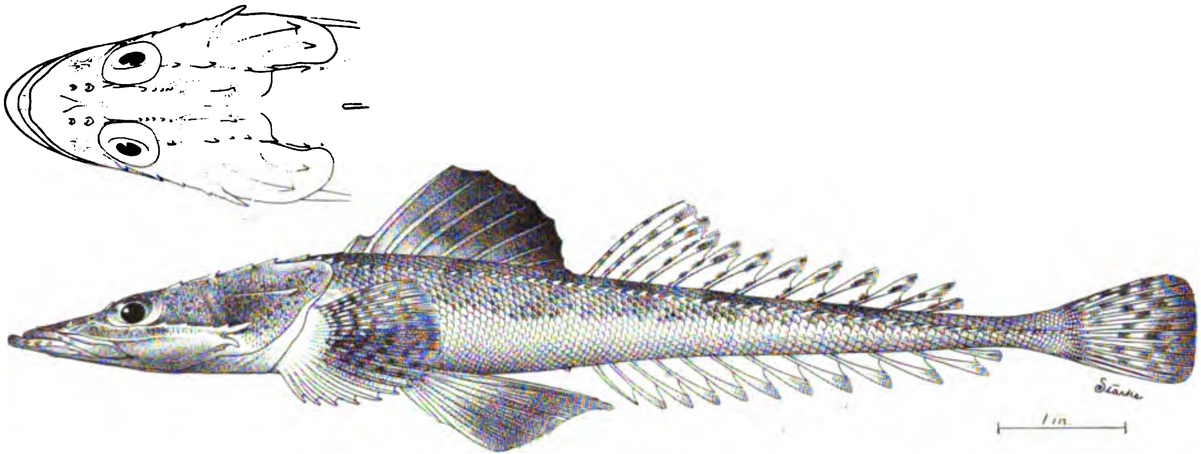
Jordan and Seale—Fishes From Hong Kong
Atkinson, Del.

AMPHIPRION POLYMNUS (LINNÆUS).

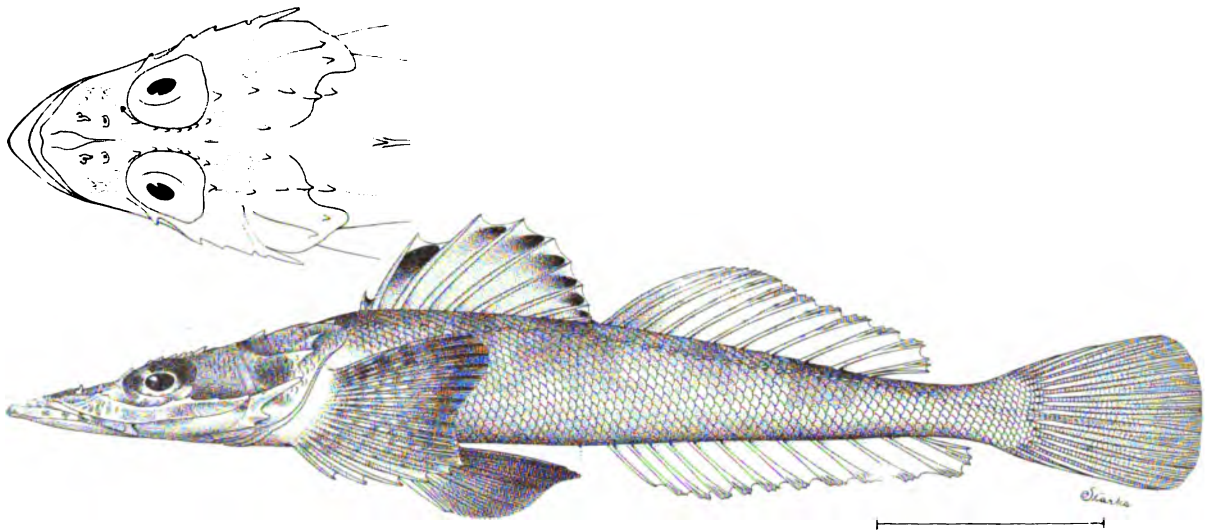
HELIOTYPE COMPANY, BOSTON



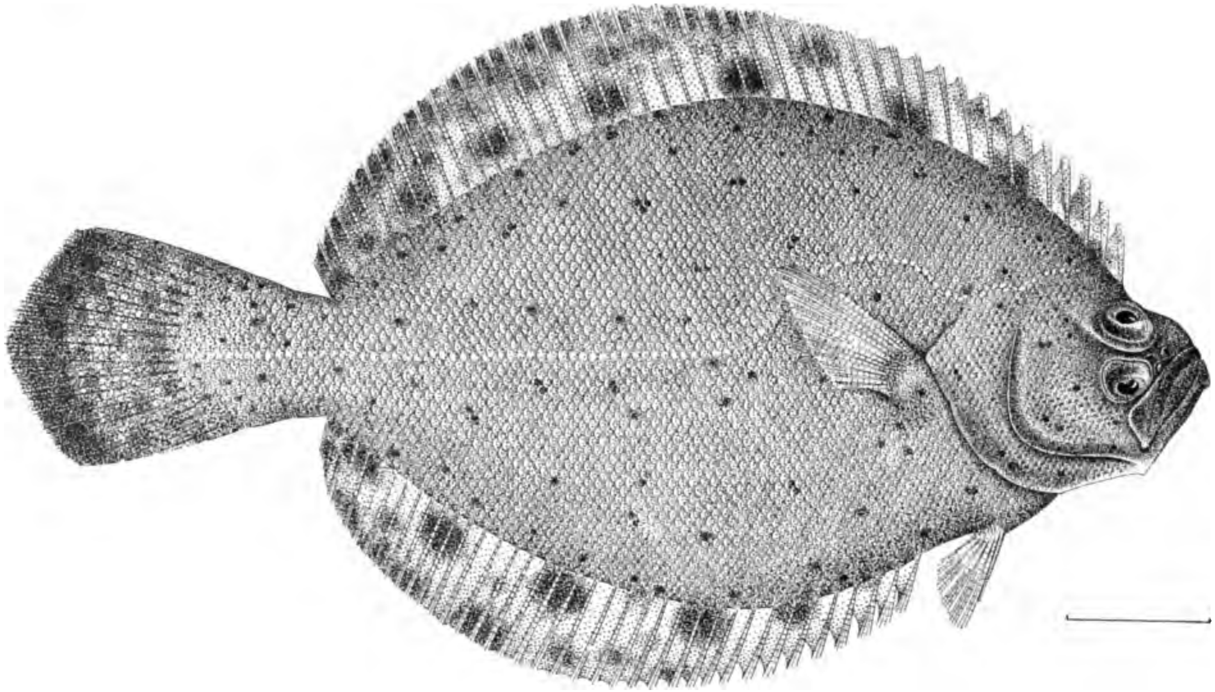
CALLYODON LIMBATUS (RICHARDSON).



INSIDIATOR NEGLECTUS (TROSCHEL).

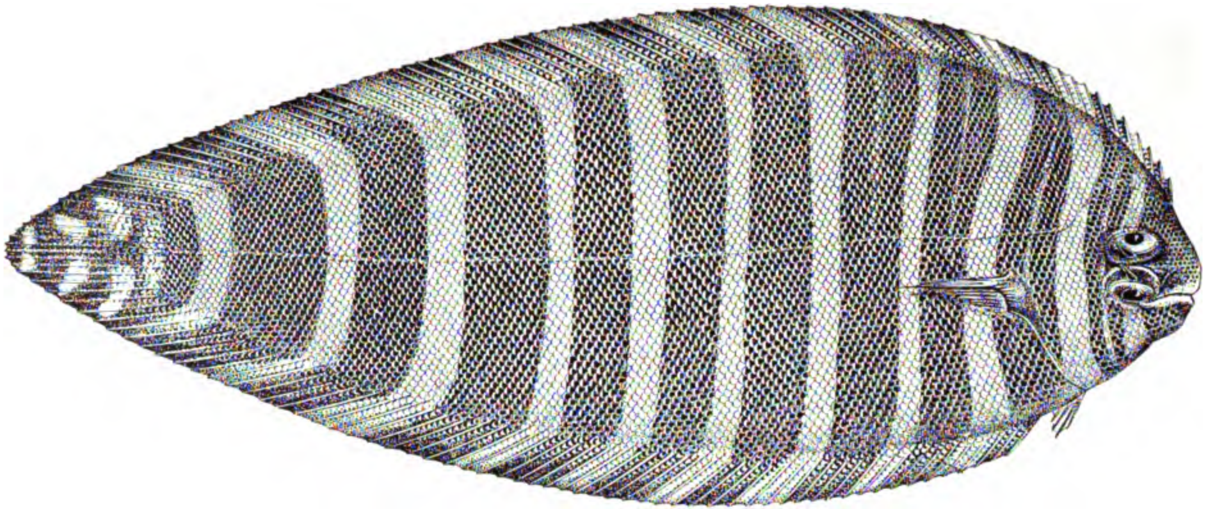


INSIDIATOR DETRUSUS JORDAN AND SEALE. TYPE.



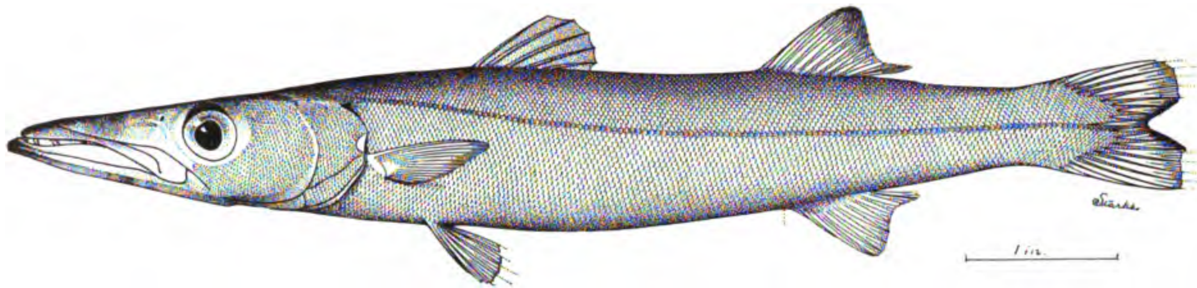
Jordan and Seale—Fishes From Hong Kong. Atkinson, Del.

TEPHRITES SINENSIS (LACÉPÈDE).



Atkinson, Del.

ZEBRIAS ZEBRA (BLOCH).



SPHYRÆNA PUTNAMÆ JORDAN AND SEALE. TYPE.

Family APOGONICHTHYIDÆ.

24. *Amia elizabethæ* Jordan and Seale, new species. (Plate 4).

Head 2.75 in length; depth 2.75; eye 3 in head; scales 26; D. VII–1, 9; A. II, 8; small teeth on jaws, vomer and palatines; posterior limb only of preopercle serrated; lateral line complete.

Color, in spirits, yellowish white, with two faint longitudinal lines on each side, the most distinct on from snout, through eye to tip of caudal; black line through base of soft dorsal and of anal, soft dorsal and ventrals tipped with black.

One specimen, No. 9064 Stanford University. Length 3 inches.

This pretty species is named in honor of Miss Elizabeth Putnam in recognition of her deep interest in biological research.

Family SERRANIDÆ.

25. *Diploprion bifasciatus* (Kuhl and Van Hasselt).

Head 2.90 in length; depth 2.20; D. VIII., 14; A. II., 12; opercle with two strong spines, lower margins of opercles and preopercles toothed.

Color, in spirits, yellowish white, with two broad black bands; one over nuchal region through eye, the other on posterior of dorsal fin to soft dorsal obliquely down to origin of anal and posterior of belly; ventrals dusky, other fins except spinous dorsal, yellow.

Two specimens. Length about 6.25 inches.

26. *Epinephelus moara* (Schlegel). (Plate 5).

Head 2.50 in length; depth 4.20; eye 6.10 in head; D. XI., 13; A. III., 8; maxillary reaching to beyond posterior margin of eye; preopercle denticulate with rather strong teeth at angle; teeth on jaws, vomer and palatines, with some canines in jaws.

Color dull grayish with darker lines on opercle, 4–5 dusky vertical bars on posterior of body, more or less broken up and sloping towards head anteriorly; fins more or less shaded with dusky.

Three specimens. Length 5.50–6 inches.

This species has been wrongly confounded with *Epinephelus nebulosus*, by Dr. Boulenger (Cat. Fishes, I., p. 240).

Family PRIACANTHIDÆ.

27. *Priacanthus tayenus* Richardson.

Head 3 in body; depth 3; eye 2.10 in head; D. X., 12; A. 13. Color, in spirits, silvery; ventrals black at tip, the ventral membranes with round purplish black spots, a large one near the belly.

One specimen. Length 3.75 inches.

It agrees well with Dr. Boulenger's description.

Family LUTIANIDÆ.

28. *Lutianus vitta* (Quoy and Gaimard).

Head 2.75 in length; depth 3.15; scales 52; D. X, 13; A. III, 7; a distinct black stripe from tip of snout through eye to caudal, an oblique narrow line on each row of scales above the lateral line and a longitudinal narrow line in each row of scales below this black band, with an indistinct spot on beginning of posterior third of the band.

Three specimens. Length 4.50–8 inches.

29. *Lutianus johnii* (Bloch).

Head 2.50 in body; depth 2.95; eye 5 in head; maxillary extending to anterior third of eye; D. X, 14; A. III, 8; scales 9–48–14.

Color, in spirits, silvery, slightly darker above, with oblique lines of scales above lateral line and longitudinal below, a large black spot on lateral line under the anterior of soft dorsal fin, a black blotch at axis of pectorals.

One fine specimen. Length 18 inches.

This specimen, evidently an adult, has but a shallow notch to preopercle and the knob of the interopercle is almost obsolete; the denticulations are stronger below the angle.

Family SPARIDÆ.

30. *Sparus sarba* Forskål.

(*Sparus latus* Houttuyn; *Chrysophrys aries* Schlegel).

Head 3.20 in body; depth 2.10; eye 3.75 in head; scales 6–64–11; D. XI, 13; A. III, 11; the second and third anal spines are equal, the second much stronger; molar teeth in three rows in each jaw, incisor rather strong and sharp.

Color, in spirits, a distinct black spot on first four scales of lateral line, color yellowish white, each scale with a brownish center giving the appearance of narrow brown longitudinal lines on body; a flaring white line from posterior axil of dorsal to below middle of spinous dorsal.

Two specimens. Length 9 inches.

These are not, evidently, different from Japanese specimens of *Sparus latus*. The black shoulder-spot, according to Dr. Day, is not found in *Sparus sarba*. It is, however, distinct in our specimens.

Family SCIÆNIDÆ.

31. *Johnius carutta* Bloch.

Head 3.30 in length; depth 3.75; eye 4 in head; snout equal to eye; no enlarged inner teeth; D. X–I, 29; A. II, 7; maxillary extending to below middle of eye; snout extending beyond mouth.

Color yellowish, a diffuse dusky blotch on opercle; spinous dorsal shaded with dusky; other fins yellowish.

Two specimens. Length about 5.75 inches.

32. *Pseudosciæna undovittata* Jordan and Seale, new species.

(Plate 6).

Head 3.50 in length; depth 3.75; eye 5.50 in head; D. X, 33; A. II, 8; scales 6–60; snout about equal to orbit; interorbital equal to orbit; distal end of maxillary extending slightly beyond posterior border of orbit. Body oblong, compressed, widest and deepest at origin of dorsal; entire body and head scaled except maxillary and lower jaw; the scales running in oblique series; depth of caudal peduncle half its length; upper limb of preopercle not denticulate; three or four small points on lower limb which are normally covered by scales; the upper limb of preopercle extends back from the vertical so that its rounded posterior margin is on a line with origin of lateral line; opercle with one small flat spine, with the membranous flap extending much beyond the spine; the tip of the snout is not very thick nor bluntly rounded as in *Sciæna;* mouth large, the lower jaw 1.98 in head; two small mucous pores on each side of lower jaw at tip; lips consisting of a rather distinct fold extending entire width of mouth; teeth of upper jaw consisting anteriorly of a single row of well separated

distinct rounded sharp teeth, the ones on each side of symphisis not larger than the others; posteriorly the teeth become small and merge into a band of villiform teeth in posterior third of jaw; teeth of lower jaw sharp and distinct, with outer scattered villiform teeth among the larger ones, a cluster of small teeth at symphysis, with two stronger curved teeth directed backwards; origin of dorsal fin on line with origin of pectorals, the two dorsals scarcely distinct; third dorsal spine the longest; pectorals 1-20 in head; base of anal 2.25 in head, being about equal to its longest anal ray; second anal spine weak, about 3 in length of longest anal ray, the spine smooth; the origin of anal midway between base of caudal and axil of ventrals; ventrals very close together, their length 1.50 in head; caudal rhomboidal, 150 in head.

Color, in spirits, yellowish white, the scales below the lateral line with yellow centers, which give the appearance of wavy oblique yellow streaks on lower sides of body; an indistinct small black spot at axil of pectorals; caudal and dorsal with slight wash of grayish; fins otherwise uniform.

One fine specimen from Hong Kong, No. 9065 Stanford University. Length 11.50 inches.

This may be the species called *Sciæna crocea* by Richardson, but the scanty description fails to apply well to our specimen. Our specimen has something in common with *Pseudosciæna amblyceps* of Bleeker, but is apparently distinct.

Family SILLAGINIDÆ.

33. *Sillago sihama* (Forskål).

One specimen. Length 9.85 inches.

Family OPHICEPHALIDÆ.

34. *Ophicephalus naculatus* (Lacépède).

Head 2.90 in body; depth 5; eye 2.75 in head; D. 45: A. 30; scales about 58; maxillary extending to posterior of eye. Ventral fin present; twelve series of scales between orbit and angle of opercles; scales of head small.

Color, in spirits, grayish olive, with two series of irregular dark blotches with light edges; two irregular dusky lines from eye, one continuing along the side, the other to base of pectorals.

Two specimens. Length 8.50 to 9 inches.

Family POMACENTRIDÆ.

35. *Amphiprion polymnus* (Linnæus). (Plate 7).

We present a plate of this handsomely colored species from the reefs at Hong Kong. *Amphiprion japonicus* Schlegel is identical with *Amphiprion polymnus*.

Family LABRIDÆ.

36. *Chœrops cyanostola* (Richardson).
(*Chœrops ommopterus* (Richardson).)

Head 3 in body; depth 2.30; eye 6.30 in head; D. XII, 7; A. III, 11; scales 4-31-9; curved canines in front of jaws; scattered scales on sides of cheeks; ventrals not prolonged, not reaching anal; posterior dorsal and anal not elongate; caudal square.

Color, in spirits, dull yellowish brown; a black spot on scales of dorsal sheath at origin of soft dorsal; a dusky line from eye to eye of snout; another from angle of face to posterior edge of subopercle; fins grayish; no white spot below black spot in the back.

One specimen. Length 10.75 inches.

According to Dr. Günther the type specimen of Richardson's *Cossyphus cyanostolus* is identical with his *Cossyphus ommopterus*, described on the next page. This is probably not the same as Bleeker's *Chœrops schœnleini*, which species has a large yellow spot behind and below the dark one on the base of the dorsal. Bleeker's species is probably Cartier's *Chœrops unimaculata*. The original *Cossyphus schœnleini* of Agassiz, from Celebes, is said to be uniform in color and is probably a distinct species, as already indicated by us in a paper on the fishes of Negros Island.

Family SCARICHTHYIDÆ.

37. *Callyodon limbatus* (Richardson). (Plate 8).

Head 3 in body; depth 3.10; eye 6.80 in head; teeth green, no posterior canine; three rows of scales on cheeks, the middle of six, the lower of two scales, which in part cover the lower limb of preopercle; caudal square.

Color, in spirits, purplish; spinous dorsal yellow; soft dorsal, anal and caudal with yellowish margin; lips yellow; ventrals with bluish band on outer third.

One specimen. Length 12.75 inches.

This specimen is different from *Scarus nuchipunctatus* Cuv. and Val. It is barely possible but not probable that *Scarus oviceps* Schlegel may prove to be based on a large example of the same species.

Family EPHIPPIDÆ.

38. *Drepane punctata* (Gmelin).

Head 3 in length; depth 1.10; D. IX, 20; A. III, 18; several small barbels on chin.

Color, in spirits, silvery, with seven to eight vertical rows of dark dots extending to a little below middle of body.

One specimen. Length 6.75 inches.

Of the various writers who have mentioned this species, but one, Mr. Cloudsley Rutter, has noticed the barbels at the chin.

Family MONACANTHIDÆ.

39. *Monacanthus chinensis* (Bloch).

Head 3.50 in length; depth 2; D. I, 29; A. 29. Two rows of large spines, of three spines in each row, on the sides of the caudal peduncle; dorsal spine with but two rows of barbs; the fan-shaped membranous portion of the ventrals extending much beyond the movable spine, dorsal and anal with numerous fine dark longitudinal lines, ventral dusky; body gray.

One fine specimen. Length 9.50 inches.

Family TETRAODONTIDÆ.

40. *Spheroides lunaris* (Bloch).

Head 3 in length; depth 3.30; eye 4 in head. Spinules on back from the snout to dorsal fin, and on belly from chin to anal opening; remainder of body smooth: fins yellowish-white; caudal lunate.

Two specimens. Length 5.20 to 8.75 inches.

Family SCORPÆNIDÆ.

41. *Sebastiscus marmoratus* (Cuv. and Val,).

Head 2.50 in length; depth 2.95; D. XII, 12; A. III, 5; 96 pores in lateral line; maxillary reaching to below middle of eye.

Color, in spirits, yellowish, marbled with dusky on sides and back; five lighter spots on base of dorsal; fins more or less blotched or dotted with dusky.

Two specimens. Length 4.30 to 4.35 inches.

Family PLATYCEPHALIDÆ.

42. *Platycephalus insididator* (Forskål).

Head 3.10 in length; depth 9; lateral line smooth; two spines at angle of preopercle; scales about 110.

Color, in spirits, with about eight to nine dusky bars over back; fins with rows of dusky spots, except caudal, which has a medial longitudinal black band and two oblique ones on each side of the middle band.

One specimen. Length 15 inches.

43. *Insidiator neglectus* (Troschel). (Plate 9).

Head 3.50 in length; depth 8.3, eye 5.50 in head; D. I, VIII, I; A. 12; 53 armed scales in lateral line; three spines at angle of preopercle; head spinous; maxillary extending to below middle of eye.

Color, in spirits, brownish above with indistinct dusky bands, white below; spinous dorsal dusky; soft dorsal, caudal and upper half of pectoral with brown spots; lower half of pectorals plain black; tips of ventrals dusky; anal white.

One specimen.

44. *Insidiator detrusus* Jordan and Seale, new species. (Plate 10).

Head 3; depth 7.75 in length (without caudal); eye 4 in head; interorbital space 3 in eye; D I, VII, 11; A. 12; scales 54; no spines on lateral line; two spines at angle of preopercle, the upper one long and strong, equal to two-thirds of eye, the lower one small; there is a minute superimposed spine on base of the long spine; a spinous ridge below the eye to base of preopercular spine with three strong backward-directed spines; a small blunt spine directly in front of eye and another one sides of snout; two very small spines on middle of snout. A short dermal flap at nostrils; superorbital spinous; a row of five distinct spines from posterior of eye to origin of lateral line; three sets of spines on nuchal

region counting the set immediately behind eye; two spines at posterior margin of opercles; head flat and wide, its width at base of preopercular spine 1.50 in head; lower jaw produced; maxillary equal in length to postocular part of head; villiform teeth in jaws, vomer and palatines; tongue trilobed as usual in *Insidiator;* origin of dorsal directly above origin of ventrals, the fourth dorsal spine the longest, 2.75 in head; base of anal equal to length of head without lower jaw; base of soft dorsal 1 20 in head; pectorals 1.80 in head; ventrals 1.75 in head; caudal rounded, 1,75 in head.

Color, in spirits, yellowish brown, with about five indistinct dark bands over back, one at origin of spinous dorsal, one at middle of spinous dorsal; one between spinous dorsal and soft dorsal; one at posterior third of soft dorsal and one on caudal peduncle; third and fourth are close together. Head with some scattered dusky blotches; spinous dorsal dusky, with deep black blotch between second and third spine and on the posterior margin of fins; soft dorsal with dusky blotch at anterior base between first and second rays, and with a small brown dot on other portion of fins; caudal plain with dusky wash on posterior half; ventrals and pectorals black, the pectorals with some ligther shade on center and at lower part of fin.

One specimen. No. 9067, Stanford University. Length 5 10 inches is type of the species.

In markings and general appearance one might easily mistake this species for *Platycephalus punctatus*, but the difference in the number of scales on the side is fully half a hundred.

Family PLEURONECTIDÆ.

45. *Tephritis sinensis* (Lacépède). (Plate 11).

Head 3.50 in length; depth 2; D. 45; A. 38; scales 94; mouth large, with several rows of small sharp pointed teeth in each jaw; eye 6 in head, very close together; interorbital space with a few scales; lateral line with a strong curve; the anterior rays of the dorsal and anal widest; ventrals short; caudal rounded, long; eyes on right side.

Color, in spirits, brown, with several black spots over body; fins blotched or shaded with dusky, with some black spots; tip of caudal black.

Two fine specimens. Length 9 to 10 inches.

In both examples the eyes and color are on the right side, which is probably the normal position in the species.

46. *Pseudorhombus cinnamomeus* (Schlegel).

Head 3.50 in length; depth 2.10; eye 5.50; lateral line strongly bent and a short curved branch or extension extending up to dorsal fin at top of head; maxillary extending to below posterior part of eye; the eyes close together; snout less than orbit; rather strong canine teeth in jaws. D. 80; scales about 86.

Color, in spirits, yellowish white, a distinct black spot at the point where lateral line becomes straight.

One young specimen of this common Japanese species. Length 4.25 inches.

Family SOLEIDÆ.

47. *Zebrias zebra* (Bloch). (Plate 12).

(*Æsopia quagga* Kaup.)

Head 4 in length; depth 2.80

Twelve black cross-bands over the body; three or four of the anterior bands appear more or less double; the black bands extend in anal and dorsal; some whitish blotches on caudal, yellow in life.

One specimen. Length 4 inches.

There is no evidence, so far as we know, that this Chinese species occurs in Japan.

48. *Cynoglossus arel* (Bloch and Schneider).

Head 4.75 in length; depth 4.25; eye 4.50 in snout; interorbital 6 in snout; D. 120; scales 96; snout 2.30 in head. Two lateral lines; eight rows of scales between them at the greatest distance apart.

Color, in spirits, dull whitish; the dorsal and anal dusky.

This fish seems to agree very closely with Dr. Day's description and figure of *Cynogloss arel* but it differs markedly in having a much larger eye and a rather more pointed snout. Unless the very small size of the eye in Day's figure is fallacious, as we suppose, the Hong Kong specimen represents a new species.

The Aftonian Gravels, and Their Relations to the Drift Sheets in the Region About Afton Junction and Thayer.

BY SAMUEL CALVIN.

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The Importance of the Region.—The glacial deposits of Iowa constitute by far the most important of the geological formations with which our highly favored state is endowed; and hence it is that all problems relating to the structure, genesis and age of these deposits are invested with a high degree of practical, as well as of purely scientific interest. Questions concerning the drift probably admit of a clearer and more satisfactory answer in Iowa than anywhere else on this continent, and the region about Afton Junction and Thayer has become classic for the reason that here the facilities for obtaining answers to some of the more interesting and significant of these questions are not surpassed, if indeed they are equalled, in any other locality in the world. Some of the most eminent students of glacial phenomena, both of Europe and America, among whom may be mentioned Penck of Vienna, McGee of Washington and Chamberlin of Chicago, have availed themselves of the rare opportunities for successful investigation which the region affords. A bed of regularly stratified sand and gravel, a true aqueous deposit more than forty

feet in thickness, is here found covering an area of considerable size and lying between two distinct sheets of glacial drift. Associated with the gravels are indications of a long interglacial interval, the evidence being expressed in the form of weathering, oxidation, leaching and general alteration of the deposits exposed. Then there are beds of peat and remains of forests which flourished during the interval in question, and these fortify and confirm the evidence from mere change in the inorganic materials. The aqueous deposits have been called Aftonian gravels, the organic accumulations are referred to as the Aftonian peat and forest beds, and the time between the disappearance of the ice sheet which deposited the first bed of drift, and the advent of the glaciers which distributed the second drift mantle, is known as the Aftonian interglacial interval. The phenomena, as they were revealed a few years ago, have been described more or less fully by Chamberlin in the *Journal of Geology*, and by Bain in the *Proceedings of the Iowa Academy of Sciences;* and the term Aftonian has taken permanent place in geological literature as the name of one of the important divisions of the glacial epoch. Recently, however, opportunities for further study have been greatly enlarged on account of the extensive improvements carried out by the C., B. & Q. railway. A number of cuts, ranging from a few feet to more than sixty feet in depth, have been made, exposing fresh sections of the glacial deposits, and revealing with a degree of clearness before unknown the true relations of the different members belonging to the lower part of the Pleistocene series. The cuts were examined when they were fresh, and on several occasions since they have been visited by parties of geologists; but slumping, overwash and erosion on the one hand, and growth of vegetation on the other, are rapidly modifying the face of the sections and obscuring the facts which they at first revealed. It seemed desirable, therefore, that the opportunities for observation should be seized while they were yet available, and that the results should be made a matter of permanent record.

Some Factors of the Problem.—The effects of five distinct glacial invasions have been recognized in Iowa, and the corresponding sheets of drift, in the order of age, have been named respectively

the Sub-Aftonian or Pre-Kansan, the Kansan, the Illinoian, the Iowan and the Wisconsin. The problems presented by the region under discussion relate chiefly to the first and second of the drift sheets and to the records of the interglacial interval by which they were separated, but there are here also some deposits which are possibly referable to the Iowan, or fourth stage of glaciation. So far as our own state is concerned, the oldest recognized glacial deposit, the pre-Kansan drift, is not surficial over any definite area. Studies near the glacial border in Missouri, Kansas and Nebraska may reveal the presence of a marginal area in which the old pre-Kansan has not been concealed by later formations; but at present no such area is known, and in Iowa, at least, the till distributed by the second glacial invasion completely covered the mantle of detritus left by the first. Our oldest till, therefore, is now seen only where it has been exposed by erosion or by the making of artificial excavations. The best natural exposures of the pre-Kansan, so far noted, are found in the bluffs on the right bank of the Grand river, about one mile south of Afton Junction. At this point the old glacial drift is overlain by the extensive accumulations of stratified sand and gravel, referred to above, and these are themselves overlain by from twenty to thirty feet of very much weathered material belonging to the age of the second ice invasion, the Kansan. The gravels have been worked extensively for railroad ballast. At an exposure one mile south of Afton Junction the beds have been removed over an area of several acres. Another large pit covering a similar area was opened and worked a few rods southwest of the present Great Western crossing at Afton Junction. A third pit, equally large, was worked near Thayer. Bain refers to these as the Grand River, Afton Junction, and Thayer pits respectively. The underlying pre-Kansan drift is now seen only at the first; the overlying weathered Kansan is well developed at all three. That the sands and gravels of these pits are aqueous in origin, admits of no question. The materials are more or less perfectly assorted and are somewhat regularly stratified (Fig. 1.) When they were laid down, the glacial conditions which gave rise first to the lower drift sheet and afterwards to the overlying Kansan, did not exist. As to their age it is certain that they are younger than the sub-Aftonian till, and they

are probably older than the Kansan; but the precise age was not regarded by Bain as more definitely settled by the evidence of the exposures available for study prior to the year 1898. Bain's studies, therefore, left the question of age somewhat unsettled. There are three possibilities. (1) The gravels may have been laid down along drainage courses by waters flowing away from the melting and retreating margin of the pre-Kansan ice, upon a surface which, but a short time before, had been left bare by the gradually waning glaciers. On this hypothesis the gravels are but little younger than the till upon which they rest. Their materials were derived from the detritus carried by the older ice sheet; they represent simply the closing phase of the sub-Aftonian or pre-Kansan stage of glaciation. (2.) The gravels may have been deposited by waters flowing out in front of the advancing Kansan ice, in which case they were laid down upon the eroded and weathered surface of the pre-Kansan till. If this be the true hypothesis, the materials should bear evidence of having been derived from the detritus carried by the Kansan glaciers, and the gravels would be but little older than the great sheet of Kansan drift beneath which they were, after their deposition, almost immediately buried. They would represent, for this latitude, the initial phase of the Kansan stage of glaciation. (3.) The gravels may have been deposited by floods which were in no way related to glacial conditions, and these floods may have occurred at any time during the long interval of mild climate which separated the pre-Kansan glacial stage from the Kansan. Which of the three possible hypotheses is correct?

Facts Bearing on the Solution of the Problem.—It is an interesting fact that the several drift sheets of Iowa differ among themselves in their physical characteristics, such as color, texture and composition, as well as in age; and it is between two sheets of drift possessing very distinctive physical properties that the waterlaid Aftonian sands and gravels lie. The sub-Aftonian or pre-Kansan till is a dark colored, fine grained deposit which becomes friable or pulverulent on drying. It is not jointed in any marked degree. On the other hand the Kansan till which overlies the gravels is normally blue or gray in color; it is a stiff clay which becomes profoundly and extensively jointed; and it dries

into hard, many-sided blocks as firm and resistant as the hardest of dried clods or sunbaked bricks. The rock fragments included in the two beds of glacial clay present great differences. The Kansan is much the richer in quartzites and green stones; the pre-Kansan is richer in granites some of which are of the coarse feldspathic type so characteristic of the Iowan drift in the north-eastern part of the state. Rock fragments are far more numerous in the Kansan than in the older till, but clear quartz sand mixed with the soft black clay is a distinguishing feature of the pre-Kansan. There are also, in the black pre-Kansan clay, numerous small pockets of yellow or orange colored sand, one-half inch to an inch in diameter, which are unknown in any of the other drift sheets of Iowa.

Now it is a fact that the coarse feldspathic granites of the sub-Aftonian till are common among the cobbles and pebbles of the Aftonian deposit, while greenstones and basalts are relatively scarce. Many of the granites are in an advanced state of decay, as shown in (Fig. 2.) Here a bowlder originally more than a foot in diameter has rolled down from the breast of the gravel pit and is rapidly crumbling into sand. It is also true that the few greenstones present show much more change than is usually seen in cobbles of the same type when occurring even near the surface of the Kansan. An altered outer zone, three-eights of an inch in thickness, is a prominent characteristic of the fractured surface when specimens are broken. Another fact of great significance is found in the highly ferruginous and profoundly weathered zone of the gravels immediately below their contact with the overlying Kansan till. This feature is especially well developed in the Thayer pit. It indicates very clearly prolonged exposure of the surface before the protecting covering of Kansan drift had been laid down upon it. A well developed soil band with traces of leaves and fragments of wood, between the upper surface of the gravels and the Kansan till, has been reported by Chamberlin and others who visited the locality before washing and sliding of the materials had concealed important details of the section. All the known facts lend support to the view that the Aftonian gravels were in place and had been profoundly altered and weathered by long ages of exposure before the arrival and deposition of the Kansan drift. The materials making up

the Aftonian gravels are certainly not of Kansan origin. The second hypothesis is untenable.

Concerning the third hypothesis, it may be enough to say that, so far as relates to the interval between the complete melting of the pre-Kansan and the incursion of the Kansan ice, there is no way at present known to account for floods of volume and duration sufficient to transport and deposit the great beds which make up the Aftonian formation. In the analogous case of the Buchanan gravels so extensively distributed throughout northeastern Iowa, there are indications which point unquestionably to their transportation and deposition by great floods liberated by the melting of the Kansan glaciers. The melting of the pre-Kansan glaciers certainly gave rise to similar floods, and it is safe to assume that these were the agents whereby the Aftonian gravels were carried and deposited. These beds bear to the pre-Kansan drift exactly the same relation that the Buchanan gravels bear to the later Kansan. There are very few points where the contact of the Aftonian gravels with the underlying pre-Kansan drift is exposed, and so it cannot positively be affirmed as a conclusion based on actual observation, that there are no indications of an erosion interval and uncomformity between them; but it may be said that at the few points where the contact is seen, there are no signs of weathering such as would have occurred if the upper surface of the pre-Kansan drift had been exposed for any considerable period before the Aftonian gravels were deposited. The weathering and other signs of age and long exposure are limited to the gravels, and chiefly to the upper part of the gravels. That these were profoundly altered before being covered and hermetically sealed by the overlying Kansan drift, is a fact everywhere apparent.

When the relations of the Aftonian gravels to the drift deposits of the region under consideration were studied by Bain, the opportunites for observation were very meager, and he was greatly puzzled by the fact that, at several points, beds of gravel, apparently undisturbed, seemed to pass by lateral transition into "bowlder clay undistinguishable from, and apparently connected with, the overlying Kansan." This seemed to him to argue a contemporaneity of age*, but he wisely left the question open

*Proc. Iowa Acad. of Sciences, Vol. V, p. 97, Des Moines, 1898.

for further investigation. The great cuts made in connection with the new work on the C., B. & Q. railway have furnished the opportunity to which he looked forward. The relations of the gravel as a whole to the associated sheets of drift are no longer in doubt; the lateral transition of gravel into Kansan bowlder clay, so apparently inexplicable when seen in a few imperfect sections, is now a matter admitting of simple and satisfactory explanation.

The Records of the New Sections at Afton Junction and their Interpretation.—A few rods west of the Great Western crossing the new line of the Burlington road passes close to the northern edge of the old Afton Junction gravel pit as shown in figure 3, and the grade, fortunately, is a few feet below the contact of the gravels with the overlying Kansan drift. The relations of the two formations are very clearly shown throughout the whole length of the space included in the figure, but it is in the cut at the extreme left of figure 3, that the most instructive phenomena of this locality may be studied. The coarser gravels making up the main body of the Aftonian deposits grade toward the top into rather fine, evenly bedded sand. When the cut was fresh, and before the carefully sloped sides had been modified by rain wash, the sharp line which separates the regularly stratified sands from the later drift, was very distinct, especially if investigated at close range. The camera does the subject only partial justice, but in figure 4 the line A A marks the division between the aqueous deposits of Aftonian age and the later glacial deposits of the Kansan. There are here no indications of transition of one into the other. The line of separation is clearly and sharply defined, and its marked regularity gives the appearance of perfect conformity between the two formations. One year later the cut was visited again, and in the mean time weathering had brought out some features not previously observed. In places the loosed Aftonian sands had fallen away, as shown in figure 5, and left recesses ranging from ten to eighteen inches in horizontal dimensions beneath the more persistent bowlder clay. A firmly cemented ferruginous crust, from one-half inch, or less, to an inch in thickness, showing somewhat distinctly in figure 5, forms a cap to the Aftonian sand. The caving and washing of

Calvin—The Aftonian Gravels. Figs. 1 and 2

Calvin—The Aftonian Gravels. Figs. 3 and 4.

Galvin—The Aftonian Gravels. Figs. 5 and 6.

Calvin — The Aftonian Gravels. Figs. 7 and 8.

Galvin – The Aftonian Gravels. Figs. 9 and 10.

Galvin—The Aftonian Gravels. Figs. 13 and 14.

the sand leaves the crust unsupported, and slabs of it, several inches in length and width, may be found broken loose from the overlying till. Now the upper surface of this crust is uniformly marked with parallel grooves and ridges resembling in every particular the effects of glacial planing (Fig. 6). The striæ have a direction a few degrees west of south, a direction that agrees well with many glacial scorings on the limestones of southwestern Iowa.

The bowlder clay which here overlies the sand and gravel, is what is known in recent geological literature as the Kansan. It is overlain by a veneer of loess (Fig. 7) which is much younger than the till, for before the loess was deposited the old drift surface had been carved by drainage waters into a system of hills and valleys showing unusually high relief for a drift-covered region. As a matter of fact the loess forms a covering of nearly uniform thickness over the hill slopes of a pre-loessial, erosional topography. During the period of erosion winds and storm waters removed the finer constituents of the drift from the surface and left a bed of residual gravel composed if the coarser materials, not so easily removed. As is well shown in figure 7, it was on an eroded surface covered with a sheet of residual gravel that the loess, in one of the later stages of the Pleistocene, was laid down. The loess is comparatively young and fresh, but the drift below it shows signs of greater age in extensive oxidation and other forms of alteration due to long pre-loessial exposure to the weather. Along the numerous joints which here, as elsewhere, characterize the Kansan till, the weathering has proceeded to depths of thirty or forty feet. These joints afforded ready passage ways for the circulating ground waters, and many of them are marked by trains and aggregations of lime nodules (Fig. 8), the materials of which had been leached from the upper part of the formation and re-deposited as concretions along the courses followed by the underground drainage. As pointed out by Bain in the Proceedings of the Iowa Academy of Sciences, Vol. V, pp. 94 and 95, and shown indistinctly in figure 4, there are faint traces of stratification in the Kansan till, but at the sections here under consideration there are no signs of transition from Aftonian to Kansan, from aqueous to glacial deposits.

Three questions are suggested by a study of the relations of

the Aftonian to the Kansan, shown in figures 4 and 5. *First*, does that even, straight line of demarcation between the two formations indicate that the drift was laid down conformably on an uneroded surface of Aftonian? *Second*, how was it possible for the ponderous Kansan glaciers to move over the loose Aftonian sands without plowing into them, destroying them, and mixing them with the detrital sub-glacial material carried by the ice? *Third*, what is the significance of the remarkable ferruginous crust (Fig 6), on top of the sand, with its parallel grooves and ridges simulating in such a striking way the effects of glacial planing? It is the purpose, at present, only to suggest possible answers to these questions. It is conceivable that the surface of the Aftonian formation may have been more or less trenched and uneven before the advent of the Kansan glaciers, notwithstanding the present evidence that here at least it was practically a plane at the time the overlying drift was deposited. It is also conceivable that the sands were saturated with water, and that just before the glaciers reached this particular locality they were frozen solid. In this condition they would be able to resist glacial grinding as effectively as ordinary limestones or sandstones. It is also conceivable that the ice planed the frozen sands to an even and more or less level surface, and that this surface was marked by parallel grooves precisely as ordinary rocks were elsewhere affected by the passage of great sheets of glacier ice. When later, during the period of wasting and retreat of the Kansan glaciers, the ice was transformed from an agent of erosion to an agent of deposition, the stiff Kansan clay was molded into the grooves on the surface of the still frozen sand. In this way the glacial groovings would be preserved intact, and the line of junction between the two deposits would be true and straight as shown in figures 4 and 5. The explanation of the genesis of the ferruginous crust (Fig. 6) presents some difficulties. It is clear that waters carrying some compound of iron in solution moved toward the upper surface of the sand, and that iron oxide was precipitated in the thin layer in immediate contact with the glacial clays. That most of this was done after the railway excavation was finished is altogether possible. It is certain that, after the cut was made, evaporation would go on rapidly from the exposed surface of the sand beds

near the bottom of the slopes; and iron-bearing waters, moving vertically or laterally through the loose Aftonian deposits toward the evaporating surface, may, by evaporation and consequent precipitation of material held in solution, have caused the cementation of the sand into the firm crust under discussion. That this crust, however formed, should retain the markings due to glacial planing, need execite no surprise when all the circumstances and possible conditions are taken into account. Concretionary nodules, well illustrated along some of the ridges toward the right in figure 6, show quite clearly that the deposition of the cementing iron oxide took place after the planing and scoring of the surface had been accomplished. Furthermore, the crust has a nearly uniform thickness, the lower face maintaining in a general way a sort of parallelism with the upper, and roughly repeating in reverse the larger grooves and ridges. The crust has developed since glaciers planed the frozen sand.

The New Sections Near Thayer, Sand Bowlders.—One-fourth of a mile west of Thayer, in another of the new railway cuts, some significant facts in the Pleistocene history of the region are very clearly recorded. It is evident, from a study of the cuts west of Afton Junction, that, in some localities, the Kansan glaciers passed over the Aftonian sands and gravels without breaking them up, or disturbing them in any way. The ice simply planed and scored the surface precisely as it might have done, and as it actually did, in moving over a bed of New England granite, or over the crinoidal limestones of Des Moines county, Iowa. On the other hand, the sections revealed by the cut west of Thayer show that, in some instances at least, the Kansan glaciers plowed deeply into the frozen gravels, broke them up into great fragments, transported the frozen masses for longer or shorter distances, and deposited them as parts of the detrital material making up the mantle of Kansan drift. In this one cut, as shown in figures 9 to 13, there are scores of "sand bowlders" ranging from a few inches to more than one hundred feet in diameter. The solid blocks of frozen sand and gravel were moved as other ponderous rock masses have been transported by glacier ice. The original bedding was undisturbed in most instances. Occasionally the frozen block was fractured and

a certain amount of faulting took place along the shearing planes. In rare instances the bowlders show effects of contortion and folding (Fig. 11); in other cases the mass was rotated through an arc sufficient to set the bedding planes at a high angle, a fact illustrated in figures 12 and 13; but not infrequently the bedding planes remain practically horizontal, as in the case of the very large body of transported gravel at the base of the slope in figure 10.

It is now possible to understand the cases reported by Bain, where Aftonian gravels seemed to give place, by more or less abrupt transition, to Kansan till, and the relations of the two kinds of material were such as to "argue contemporaneity of age."* The experience of the Great Western Railway Company, which began to open up a body of gravel and soon found that the steam shovel was handling nothing but bowlder clay, might be repeated at the locality shown in figure 12. Here is a great body of excellent gravel, presenting a cross section more than one hundred feet in length and fully twenty feet in height, that, when the cut was fresh, looked like a section of a gravel kame. It is, however, nothing more than an unusually large sand bowlder. Later weathering has shown that the enormous mass of gravel was tilted in the process of transportation so that the bedding planes stand at a high angle. In its history and its relations to the Kansan till, notwithstanding its great size, it does not differ from the smallest of the sand bowlders shown in figures 9 and 10. If these were granite bowlders, and not mere masses of stratified sand and gravel, instead of arguing contemporaneity of age, the relations would afford positive demonstration that the granite is older than the till in which it is incorporated. The sand bowlders tell the same story concerning the relative age of the Aftonian and the Kansan, a story which is abundantly corroborated by the stratigraphic relations and other lines of evidence.

Bowlders of Pre-Kansan Clay.—In the numerous sections of Kansan drift exposed by the new railway cuts between Thayer and Afton, bowlders of pre-Kansan till, as well as bowlders of Aftonian sands and gravels, are not infrequent. As hereinbe-

* The Aftonian and Pre-Kansan Deposits in Southwestern Iowa, by H. Foster Bain; Proc. Iowa Acad. of Sc., Vol. V, Des Moines, 1898.

fore noted, the lower till differs in color, texture and other physical properties from the overlying Kansan. It is a very dark clay which crumbles readily on drying, and this characteristic, together with its small pockets of yellow colored sand, renders it conspicuously distinct from the clays distributed by the second glacial invasion. At many points in the numerous exposures recently opened to investigation, imbedded in typical Kansan clays, there are masses of the dark sub-Aftonian till, with its pockets of yellow sand and other distinguishing characteristics. One of these, the body which makes up the dark prominent mass in the center of figure 14, shows evidence of having been rolled and kneaded in the process of transportation.

Summary of the Evidence.—The evidence now before us shows two things. First, in certain localities the Kansan ice rode over the older deposits without causing any break or disturbance, in which case the materials of the older formations occupy their proper stratigraphic relations to the newer Kansan till. Second, under certain conditions the glaciers of the Kansan stage plowed up the Aftonian and sub-Aftonian beds and incorporated masses, varying from a few inches to many feet in diameter, in the great sheet of Kansan drift. The evidence probably warrants a third statement to the effect that, when all the facts are taken into account, there is no transition of Aftonian gravels to Kansan clays and nothing that argues contemporaneity of age.

The Aftonian a Real Interglacial Interval.—That the Aftonian was a real interglacial interval of mild climate and of long duration, is demonstrated by the evidence of extensive peat beds and forests which developed on the surface of the pre-Kansan drift, and were later overwhelmed and buried by the glaciation of the Kansan stage. In McGee's *Pleistocene History of Northeastern Iowa*, in the Eleventh Annual Report of the United States Geological Survey, there are numerous references to a soil and forest bed which the author assumed to lie between his lower and upper till; but, as the Pleistocene deposits are now divided, the organic material would be referred, in practically every case there mentioned, to the Aftonian horizon. Similar evidence of a soil, peat and forest horizon beneath the Kansan drift is noted

in many of the county reports published in the volumes of the Iowa Geological Survey. On pages 54 to 68 of volume IV, *Proceedings of the Iowa Academy of Sciences*, there are detailed descriptions of the Aftonian peat bed in the classic section at Oelwein. The latest evidence of a long, mild interval between the pre-Kansan and the Kansan stages of glaciation is presented by Savage in his descriptions of a buried peat bed in Dodge township, Union county, Iowa, published in the *Proceedings of the Iowa Academy of Sciences*, volume XI.

DESCRIPTIONS OF FIGURES.

Figure 1. South side of the gravel pit at Afton Junction, showing definite stratification.

Figure 2. Decayed granite bowlder which has fallen from the face of the excavation here made in Aftonian gravels and is undergoing rapid disintegration. The softened nucleus, ready to crumble to pieces on the slightest touch, is surrounded by a miniature talus of disintegrated fragments.

Figure 3. The north side of the gravel pit at Afton Junction. View shows new railway grade, and the heavy body of Kansan till above the gravels.

Figure 4. First cut west of the Afton Junction gravel pit showing the even line of contact, A A, between the Aftonian deposits and the Kansan till. View shows north side, and was taken when the cut was fresh, in August, 1901.

Figure 5. South side of the cut illustrated in figure 4, as it appeared in August, 1902. The edge of the ferruginous crust and the effects of caving of the loose sand beneath it are seen at AA. The material above the contact line, A A, is Kansan till.

Figure 6. Fragment of the ferruginous crust, one-half natural size, showing the straight parallel grooves and ridges on its upper surface.

Figure 7. View showing thin sheet of residual gravel between loess and Kansan drift and illustrating the practical parallelism between the pre-loessial and the present topography. The loess is young as compared with the Kansan drift.

Figure 8. The sloping side of the new cuts showing trains and aggregations of concretionary calcareous nodules along joints in the Kansan clay.

Figure 9. South side of the first cut west of Thayer, showing numerous "bowlders" of Aftonian sand and gravel incorporated in the Kansan drift.

Figure 10. A very large "sand bowlder" at the base of the cut, with others of smaller size; near Thayer.

Figure 11. "Bowlder" of Aftonian sand, crumpled and folded, north side of cut near Thayer.

Figure 12. A kamelike mass of the Aftonian, tilted in process of transportation.

Figure 13. Portion of a large "sand bowlder" with beds slightly folded and inclined at a high angle.

Figure 14. A "bowlder" of pre-Kansan. The prominent dark body in the center of the view is a rolled and contorted mass of the older drift embedded in the Kansan, while above it, and to the right, is a "gravel bowlder" from the Aftonian.

A Comparative Study of the Vegetation of Swamp, Clay, and Sandstone Areas in Western Wisconsin, Southeastern Minnesota, Northeastern, Central, and Southeastern Iowa.

BY L. H. PAMMEL.

In presenting this paper the writer has attempted to bring together certain interesting facts pertaining to the flora of a few isolated areas of Iowa, Wisconsin, and Minnesota, calling attention to the local distribution of some plants and their relation to the physiographic condition of the region.

In the year 1883, when a student at the University of Wisconsin, I began the study of the flora of southeastern Minnesota and western Wisconsin. A collection of plants was made, and added to from time to time since. Little, however, has been published on the flora that is interesting from a geographical standpoint. The local distribution of a few of these plants depends upon physiographic conditions peculiar to the region. Some time has also been spent in studying the flora of central Iowa. Here again we have some interesting local physiographic conditions, and a few plants that are local in their appearance. These rare plants are found upon the sub-carboniferous sandstone of the region. The writer has also had an opportunity to study the peculiar flora in Muscatine and Marion counties, with small outcrops of sandstone. These areas likewise contain plants that are in part quite local to the regions.

Published accounts of the flora of the regions named are not numerous. The best paper treating with the ecological aspects of the region is that by Prof. Wheeler on the flora of southeastern Minnesota.[1] Prof. Wheeler, however, made a study of Winnebago and Crooked creeks in Houston county only. After a brief discussion of the physiography of the region, Prof. Wheeler treats the formations under the following heads: Plankton; attached, submerged, aquatic plants; attached aquatic

1. Wheeler, W. A.—A Contribution to the Knowledge of the Flora of Southeastern Minnesota. Minn. Bot. Stud. 24: 353-416. Pl. 21-27.

plants with natant leaves; adaptive shore plants; wet meadows of the river valley, mud flat vegetation, creek valleys, cold spring vegetation, pond vegetation, wet vegetation of the creek valleys,

FIG. 1. Map of Western Wisconsin, Southeastern Minnesota and Northeastern Iowa. Charlotte M. King.

moist wood vegetation, mesophytic field vegetation, moist cliff vegetation, vegetation of wooded slopes, ridge forest vegetation, base slope and open ridge vegetation and dry rock vegetation.

Lueders, in his account of the vegetation of the town of Prairie Du Sac, in Sauk county, as well as the paper by Dr. Parry, considers the physiographic conditions as having an important bearing on the distribution of plants. The paper by Wheeler gives a good analysis of the flora and of the different formations. The following systematic papers[1] should be mentioned: The paper by L. S. Cheney and R. H. True on the flora of Madison and vicinity, and papers by the writer and Prof. Greene, also papers by Prof. Macbride on trees and shrubs of Allamakee county.

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1 Barnes, Reppert and Miller. The Flora of Scott and Muscatine Counties; Proc. Davenport Acad. of Sci. 1900: 199.
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The paper by Dr. Fink on the Spermaphyta of Fayette, as well as notes by Shimek on the Aquatic Plants of Northern Iowa and Notes on the Flora of Iowa, and the paper by Cratty on the aquatic plants, touch upon interesting phases of the flora included in this article. The paper by Cameron on the Trees and Shrubs of Delaware County, and the very excellent paper by Barnes, Reppert and Miller on the Flora of Scott and Muscatine Counties touch upon the floras peculiar to some of the regions of the state.

For the sake of convenience, we will discuss the subject under the following heads: Topography, Geology, Climatology, Physical Properties of Soils, Chemical Properties, Bacteria of the Soil, Plant Formations, The Algal Flora, and Local Problems in Geographical Distribution.

TOPOGRAPHY.

WESTERN WISCONSIN, SOUTHEASTERN MINNESOTA AND NORTHEASTERN IOWA.

The region here considered is embraced in the counties of La Crosse, Trempleau, Vernon and part of Monroe. The region is well watered, containing several perennial streams of considerable size. The Black River rises northeastward and flows through a country once heavily timbered with white pine. The Kickapoo, with its several branches, rises in Monroe county where there are many swamps which are in part drained by the eastern part of the Kickapoo River, while the northern part of the county is swampy in many places and drained by the Lemonweir River, which flows into the Wisconsin River below Mauston.

The La Crosse is the smallest of the three streams. This rises in Monroe county and drains many small marshes, receiving numerous small brooks and creeks that rise in the hills adjacent to its valley. In part the river has made its way through a Jack-pine plain region near Sparta and small prairie-like openings.

In addition to these streams mention may be made of such streams as the Mormon Cooley, Chipmunk, State-road Cooley, Bostwick, and Smith's creeks and the Bad Axe and Coon rivers. In former times the Mormon, Bad Axe and Bostwick contained a much more even flow of water than at the present time. The

flow was more regular, since these streams had water sufficient to run flourishing flour mills during the entire year. The spring water comes from various sources, the best and largest springs coming from the St. Croix sandstone area. Another class rises below the Oneota limestone and the third class rises in the marshes and bogs.

Between La Crosse and Geneva, on the Wisconsin side of the Mississippi, precipitous bluffs face the river, having an elevation of 460 to 500 feet above the flood plain of that river. There are, however, bluffs to the north that are 600 feet above the Mississippi flood plain. The topography of the Minnesota side is essentially the same. There are a half-dozen small streams, the most important being the Root River and Pine Creek. By far the greatest volume of water, however, is carried by the Root River. The higher bluffs on both the Wisconsin and Minnesota sides are generally bare and very dry. The ridges are frequently long and always narrow. Eastward from the Mississippi the bluffs are less precipitous and the ridges widen into flat or rolling areas and these are of considerable size. To the south these areas are common, with quite deep valleys.[1]

The rock exposure toward the Mississippi River consists mainly of St. Croix sandstone of great thickness, capped with a thin layer of Oneota. At the base of the bluffs toward the river are sandy plains; but the valleys vary greatly in width. The soil of the valleys consists of a yellow loam, but near the creeks and rivers it is a black alluvial. Bogs and marshes have formed under favorable conditions. North of La Crosse, and including the Black River district, the hills are low and sandy, often with deep ravines. The Black River district is a network of sloughs and marshes, but in the older flood plains is drier. Here there is a scattered growth of Norway pine, red cedar, swamp white oak and green ash. The sandy uplands often form low prairies of fair fertility. Swamps are, however, common also in other parts of the region. In part, these swamps are surrounded by low hills and terraces. Taking these meadows in the vicinity of La Crosse, close to the mouth of the river, as a typical illustration, we have a marshy plain and an elevated sandy prairie that rises between

1. Geol. of Wis. 4: 1.

thirty and forty feet above the flood plain of the La Crosse River. On the west side of the Mississippi, except in Houston county, there are swamps and marshes not unlike those on the east side of the river, but they are not nearly so extensive. The same may be said of Allamakee county in northeastern Iowa. At the mouth of Red River and Pine Creek in Minnesota there are extensive alluvial bottoms where soil of great fertility has formed. The back-waters of the Mississippi near the mouth of Pine Creek have

FIG. 2. Bluffs along the Mississippi River near Lansing, Iowa. Hard Maple, *Acer nigra*, on high bank. Basswood, *Tilia americana*, Black Walnut, *Juglans nigra*, on banks above the alluvium. Black Birch, *Betula nigra*, Cork Elm, *Ulmus racemosa*, Soft Maple, *Acer saccharninum*, on alluvium. Photograph by Charlotte M. King.

formed a lake of considerable size known as Target Lake. In the vicinity of La Crosse, and Houston, Minnesota, as well as New Albin in northeastern Iowa, there is a well-marked terrace formation.

Moses Strong[1] made three natural divisions in the Wisconsin area here considered. First, high, rolling table-land cut up by

1. Moses Strong, Geol. of Wis. 4: 1.

numerous ravines, the larger ones called coulés (Cooley) or valleys, the ridges rising from three hundred to five hundred feet above the flood plains of the Mississippi. Naturally the soil is a clay derived from the Oneota limestone. This includes the south half of Richland, Crawford, La Crosse and Trempleau counties.

The third area includes the alluvial flood plain in the valleys of the La Crosse, Black, Kickapoo and Trempleau rivers. The material is of glacial origin, except parts of the Kickapoo and La Crosse rivers.

The principal streams of northeastern Iowa are the Upper Iowa, Yellow and Turkey rivers. At the mouth of the Upper Iowa a large alluvial bottom has formed. It is similar to that of the Root River. A very good idea of the topography may be obtained from Prof. Calvin's account.[1]

At Postville the elevation is 1200 feet above the sea level. Postville is situated upon the high land south of the Yellow River and Prof. Calvin is responsible for the statement that at the crest between the Oneota River and Village Creek the land is not only higher than any other in the county, but, beyond that fact, it contains the highest land, at corresponding distances from the Mississippi River, between St. Paul and the Gulf of Mexico. In its general topography this region is similar to that found in Vernon county in the vicinity of Viroqua and Coon Prairie.

"In Allamakee county there is no mantle of drift and there are no indications of invasion by glaciers. The topographic characters imposed by long-continued action of solution and mechanical erosion have never been obscured or modified in any essential or fundamental degree. The surface, therefore, is gashed and furrowed in every direction by an intricate system of ramifying erosion channels. Some small areas in the southwestern part of the county are comparatively level. Ludlow and Union Prairie townships present more of the unusual features of Iowa topography than any other portions of the county. Elsewhere throughout the county topographic forms are bold. Rounded, steep-sided ridges, with gorges and ravines sharply angled at the bottom, prevail except in or near the valleys of the main drainage streams."

1. Ia. Geol. Surv. 4: 2.

CENTRAL IOWA.

For central Iowa two areas will be considered: parts of Hardin and Marshall counties along the Iowa River, and Boone and Story counties along the Skunk and Des Moines rivers.

Hardin and Marshall Counties.—The drift sheets have influenced the general topography of the region in a marked way. Dr. Beyer[1] divides Hardin county into three topographical provinces.

FIG. 3. Sandstone formation in Hardin County. White Pine and Cherry and White Birch in foreground. Photograph by Charlotte M. King.

The first is the loess Kansan type which comprises about one-sixth the superficial area of the county. This area is perfectly drained and includes part of the townships of Providence and Union in the southeastern part. The second province is the Iowan drift plains and comprises the south half of Aetna and the northeast half of Clay township. This is a portion of the great Iowan drift plain which extends from Minnesota across the state through

1. Ia. Geol. Surv. 10: 247.

Worth, Cerro Gordo and Franklin counties. Here the streams have done little cutting. The third province is the area covered by the Wisconsin drift sheet and covers more than four-fifths of the county. The eastern margin is marked by the Altamont moraine.

The chief drainage areas under consideration are Pine and Elk creeks, which lie in the Kansan drift. The Iowa River, which flows through the county in a southeasterly direction, entering the county in Alden township, cutting through the Kinderhook series at Iowa Falls, forms a gorge at Iowa Falls with a height of eighty feet. Between Steamboat Rock and Eldora, at several points, ferruginous sandstone faces the river. In the Iowan drift in Clay township the hills are thickly covered with timber and with small alluvial areas. Below Eldora the alluvial areas increase in size, forming a wider flood plain of the river.

Marshall County.— The whole county is covered by drift, but there are three distinctive areas occupied by the Wisconsin, Iowa and Kansan drift sheets which Dr. Beyer[1] designates as the drift, drift plain and drift loess types. In the western part of the county are many sloughs and "kettle holes." The northeastern part of the county is a slightly rolling plain, with sloughs. The drift loess type contains many small streams and numerous hills. Near the Iowa River, extending in a southerly direction, a few miles south of Albion is a sand-bar that traverses the county, extending southwestward. On the east side of the river is an eminence known as Mormon Ridge, which is heavily covered with timber. The principal streams are the Iowa River, Timber Creek and Minerva and Honey creeks.

Story County.— The surface of the county is gently rolling and, as Dr. Beyer says,[2] "it is the typical saucer topography so characteristic of the younger drift sheet." Several prominent moraines occur in the county, the Gary, which enters the county from Boone in Lafayette county to Lincoln township. The Altamont moraine touches the county in its eastern part from Sherman to Collins townships. This marks the western boundry of this

1. Ia. Geol. Surv. 7: 203.
2. Ia. Geol. Surv. 9: 459.

moraine. Dr. Beyer gives the altitude of the Altamont moraine near Collins as 1022 feet. The Gary moraine near Summit has an altitude of 1075 feet. The principal streams are Skunk River and Squaw and Indian creeks. According to Dr. Beyer it seems highly probable that the headwaters of the present Des Moines found their way to the Mississippi through the Skunk.

Boone County.— The topography of Boone county has the character of a drift plain. It is flat, except near the streams. The Des Moines, which is the principal river, enters the county in Pilot Mound township and flows in a southerly direction, dividing

FIG. 4. Story County. Wooded area along Squaw Creek. *Tilia americana* and *Ulmus fulva*. Photograph by C. M. King.

the county into two parts. The Des Moines valley is narrow, with numerous small tributaries, also narrow, often with gorges. The most important of these are found in the vicinity of Moingona, commonly called the Ledges.

The streams are Bear, Pease, Eversole, Caton, Elk and Bluff creeks. The terraces along the Des Moines River, and other

streams, show the recent development of these streams. Squaw Creek, a tributary of Skunk River, drains the northeastern part of the county.

NORTH CENTRAL IOWA.

The bogs are developed altogether in the glacial area.[1] The general landscape is flat and there are very few valleys except for a few of the larger streams. The hills are low and rounded, being especially developed in the northern part of the area, as in Cerro Gordo and Worth counties and the counties westward. Between these hills, especially in the northern area, are small basins. Dr.

FIG. 5. Ledges, Boone County, Iowa. The dry sandstone exposures. Red, White, and Chestnut Oaks, and Quaking Asp. *Carpinus* and *Ostrya* in timbered areas. Photograph by J. I. Caughey.

Bain says "the low swells contain few sharp contours and are not pronounced enough to deserve the name of hills. They have little individuality and are not arranged according to any order or system. Between them lie ill-defined basins occupied usually by shallow ponds, swamps or swale-areas of slough or shallow water. There are very many basins without outlets, and the whole is clearly a region of immature drainage. At many points springs and shallow artesian wells attest the superabundance of water. . . . The numerous lakes and ponds, the undrained sloughs, the peat bogs, the narrow river valleys, the incomplete drainage, the undissected upland between the rivers, some of which flow 200

1. Ia. Geol. Surv. 6: 431.

feet below the general plain, and many other features all point to one conclusion—that the topography is extremely young and that it was formed by glacial agencies."

The region has a number of important streams, the Cedar, with its several branches, rising in Cerro Gordo, Worth and Mitchell counties, the Iowa River in Hancock, one branch of the Des Moines in Emmet county and the other in southern Minnesota. The source of these streams is in several lakes. West of the Des Moines basin the rivers flow into the Missouri. Throughout the entire region there are numerous moranic gravel hills, bogs and marshes. The flood plains of the streams are generally narrow, and the large marshes in Wright county and north are flat. This indicates an ancient lake of considerable size. Similar flat expanses occur in Palo Alto, Kossuth and Humboldt counties.

GEOLOGY.

WESTERN WISCONSIN, SOUTHEASTERN MINNESOTA AND NORTHEASTERN IOWA.

The region here considered lies in the driftless area and so has not been modified by glacial action. The broad valley of the Trempleau River is apparently the boundry below which the glacial deposits were not formed. Opposite La Crosse in Houston county, Minnesota, and along the bluffs east of La Crosse and near the mouth of Mormon Cooley Creek, are small deposits of silicious sand, some clay and small gravel. The rounded pebbles are small and consist of quartz, granite, trap and other archæan rocks. These banks are usually covered with sandy humus. Strong holds that this material was brought down by the Mississippi River from the north.[1]

The greater part of the area in Wisconsin and Minnesota bordering on the Mississippi River consists of the St. Croix sandstone. This formation occurs in valleys frequently forming sandy prairies.

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1 For a discussion of the formation see Moses A. Strong, Geol. of Wis. 4: 1–98.

W J McGee, The Pleistocene History of Northeastern Iowa, U. S. Geol. Surv. 11: 190.

Samuel Calvin. Ia. Geol. Surv. 4: 42.

Chamberlain and Salisbury. Rept. U. S. Geol. Surv. 6: 286.

The strata in the vicinity of La Crosse and Trempleau attain an elevation of 470 feet. Farther northward the elevation diminishes, becoming the surface rock.

This material is made up of a yellow stratified sandstone, green sandstone and shale, hard, compact yellow sandstone, a heavy-bedded, regularly stratified, hard, white sandstone, and a yellow sandstone. These different layers support a somewhat varied flora, depending upon the slope and the amount of soil covering the rock. In some sections the sandstone is often very ferru-

FIG. 6. Kettle-hole in Marshall County, Iowa *Typha latifolia*, *Iris versicolor*, and *Phragmites* are conspicuous plants. Photograph by Dr. S. W. Beyer.

ginous. The iron found here is a surface deposit derived from the upper ferruginous bed. It is not rich in fossils. The richest fields are found in the southern part of Trempleau and northern part of La Crosse counties. The St. Croix sandstone is exposed in numerous places in Allamakee county, Iowa, according to Prof. Calvin,[1] At Gabbet's Point it rises 300 feet above the level of the river. Towards the head of the Oneota River it is only a few feet

1. Ia. Geol. Surv. 4: 55.

above the channel. At New Albin, near the Iowa-Minnesota line, it is given at 320 feet.

The lower magnesium limestone of Chamberlain or the Oneota is the surface rock of the higher ridges about the heads of the small streams and valleys. This limestone covers all of the higher hills along the Mississippi. On one of the highest bluffs along the Mississippi the heavy-bedded limestone is 90 feet thick—thick magnesium layers alternating with sandstone 50 feet, then bedded yellow shales alternating with white and yellow sandstone. The Oneota limestone covers the St. Croix. Calvin[1] says "The Oneota limestone is one of the most conspicuous and at the same time one of the most important of the geological formations in Allamakee county. It lies directly and conformably upon the St. Croix sandstone, the transition from one formation to the other being made through some fifteen or twenty feet of calciferous sandstone." There are few exposures of Galena limestone on the ridges between the Little Kickapoo and the Mississipi rivers.

The St. Peter sandstone occurs in the shape of mounds and cliffs. In the area under consideration it occurs in Vernon, Monroe, and Buffalo counties. It is the surface rocks in part of Vernon county near Coon Prairie on the ridge dividing the Kickapoo and the Mississippi rivers. These ridges are about a mile and half wide, extending in varying widths and broken mounds to Viroqua. Isolated areas occur in Monroe county on the ridge that divides the Kickapoo from the La Crosse River. In the southern part of Buffalo county there are small exposures between Eagle Creek and Trempleau River. The vegetation of the Wisconsin and southeastern Minnesota region is, therefore, largely influenced by the St. Croix and lower magnesium or the Oneota limestone. The St. Croix sandstone and Galena limestone do not show any marked deviation of plants found on the St. Croix sandstone and the lower magnesium limestone.

The St. Peter sandstone in Allamakee county as limited by Calvin[2] is as follows: "Limiting the term in accordance with its original application, the St. Peter sandstone of Allamakee county embraces a body of but slightly coherent arenaceous deposits

1. lc. 61.
2. lc. 68.

having an average thickness of about eighty feet, and lying between the fairly well defined summit of the Oneota and the very definitely marked bed of shale that is found everywhere throughout the county at the base of the Trenton."

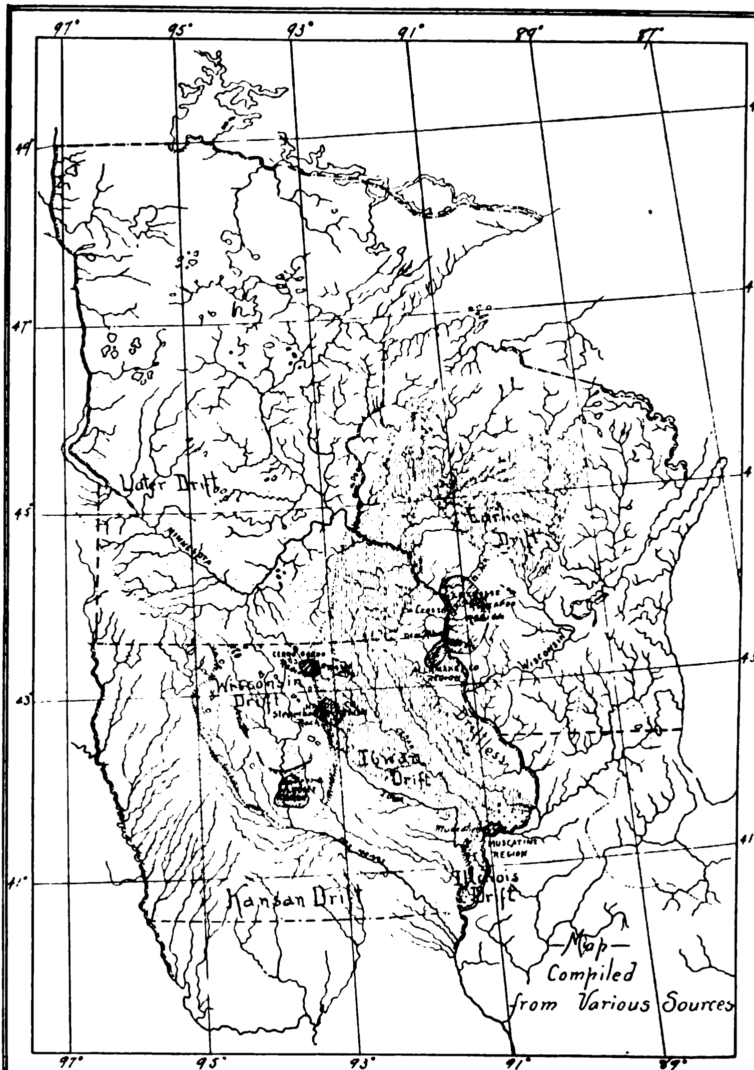


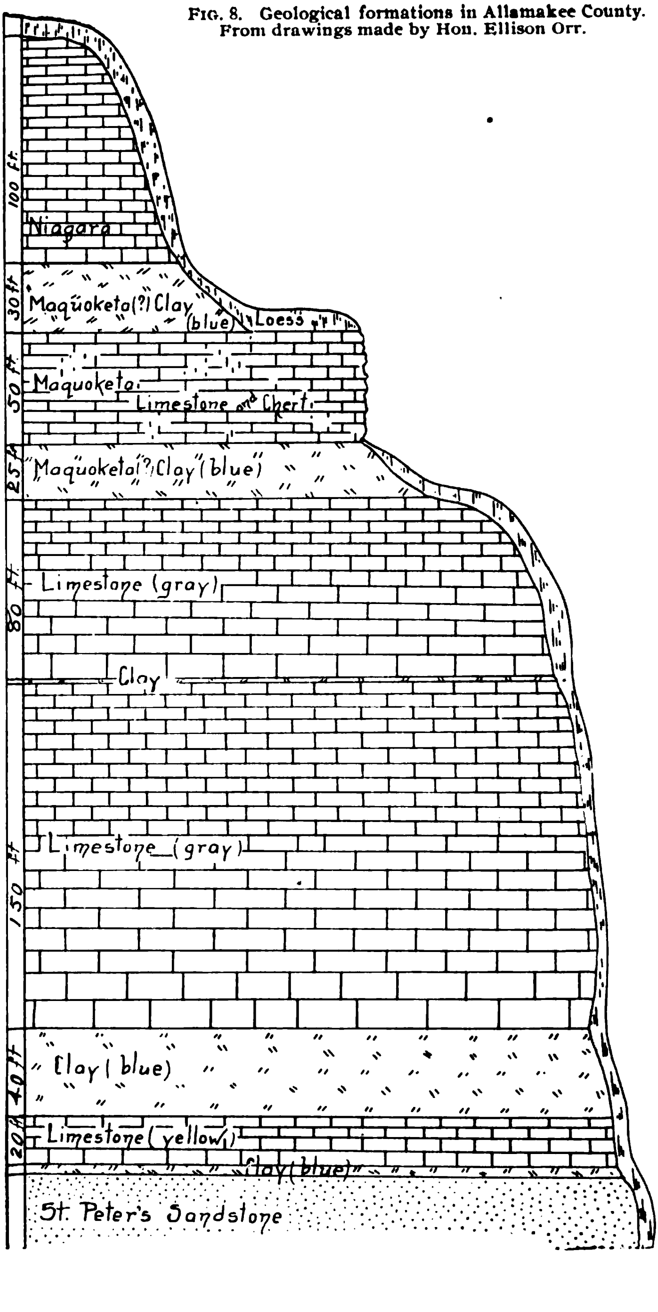
Fig. 7. Geological map showing various drift areas. Map complied from various sources by Charlotte M. King.

CENTRAL IOWA.

Hardin County.—Dr. S. W. Beyer says,[1] "Geologically the county is of especial interest because it is one of the border counties of the productive coal measures, and its surface has been modified by at least three ice invasions." There are two series to the carboniferous system in the county; the first is essentially limestone, which Dr. Beyer refers to the Mississippi series, the second comprises a ferruginous sandstone and shale and is referred to the Des Moines. I shall deal with the flora of the carboniferous sandstone only. Dr. Beyer describes this sandstone as follows:[2] "The beds consist of an upper heavy-bedded ferruginous sandstone which often presents conglomerate to concretionary facies and is cross-bedded throughout; and lower shales which carry some coal and often contain highly calcareous, fossiliferous ledges." These sandstone ledges extend along Pine Creek and some of the smaller streams that are tributary to the Iowa River. These beds reach their greatest thickness about two miles north of Eldora where they are about eighty feet thick. The Wisconsin, Iowan and Kansan drift sheets occur in Hardin county on the Kansan drift. Dr. Beyer[3] says "The Kansan is known to cover the entire county, but is everywhere more or less obscured by later deposits." The drift sheet along the Iowa River between Steamboat Rock and Eldora is the Kansan, overlaid with a loess deposit. The Iowan drift is developed in eastern Aetna and along Clay township. "The most marked characteristics of the Iowan in Hardin[4] county, as elsewhere, are its almost monotonously level surface and its train of giant boulders." The Wisconsin drift covers the western two-thirds of the county. The marginal belt of this is from two to five miles wide, according to Dr. Beyer, and extends "through Marshall, Story, and Polk counties to Capitol Hill, Des Moines, and with the moraine of Cerro Gordo and Worth counties is known as the Altamont moraine." Dr. Beyer,[5] in describing the Wisconsin, says, "As in Story county, certain more or less broken

1. Ia. Geol. Surv. 10: 245.
2. lc. 271.
3. lc. 279.
4. lc. 280.
5. lc. 283.

Fig. 8. Geological formations in Allamakee County.
From drawings made by Hon. Ellison Orr.



chains of ridges and knobs concentrically arranged may be noted within the area outlined by the Altamont. These concentric chains indicate halts in the retreat of the ice lobe and have been designated recessional moraines by the leading authorities on glacialogy. The general surface or ground moraine of the Wisconsin has undergone very little modification since the retreat of the ice."

Boone County Geology.—In Boone county the geological formations have been referred to by Dr. Beyer [1] in two series, the carboniferous and pleistocene. The lower carboniferous formations occur in this county as well as Story, but are not exposed in Boone county. There is a typical exposure of the St. Louis limestone near the eastern border of the county in Story. Drift material is present everywhere and this varies from 60 to 200 feet in thickness. The Des Moines has cut into this carboniferous formation channel with an average depth of 100 feet, showing exposures of sandstone and shales. Drift material covers the entire county except where it has been removed by the present streams, Dr. Beyer giving the thickness at Zenorsville from 60 to 120 feet, at Boone 200 feet. The county is underlain by two drift sheets, the Kansan, which is only exposed at a few points. Boone county lies wholly within the Wisconsin drift sheet and wholly within the outer loup of the terminal moraine and is bounded by the Altamont moraine. In the northern part of the county there is an ancient moraine, the Garry.[2]

The Cerro Gordo and Worth County Bogs.—It is convenient to consider these bogs in connection with the geology of Boone county as these bogs occur in the Wisconsin drift area. The region here considered is not far from Lime Creek in Cerro Gordo county. It rises in Winnebago county, flows northeasterly across the northwestern part of the county following the morainic belt, in Worth county flowing eastward. Then leaving the moraine, it flows southeasterly over the Iowan drift. The region in Worth and Cerro Gordo counties included in the Altamont moraine consists of numerous "knob-like hills and undrained marshes arranged in the most lawless manner," as so

1. Ia. Geol. Surv., 5: 184.
2. Ia. Geol. Surv., 5: 203.

well described by Prof. Calvin.[1] "The hills are simply knobs of drift that were irregularly heaped up along the margins of the Wisconsin ice. Their height above the tortuous, marshy valleys that wind in and out and branch and rebranch without definable system so as to practically surround each individual knob, varies from forty to seventy or eighty feet." Kettle holes are numerous. Calvin describes these as follows: "They are abruptly depressed below the surrounding level, but they may be found in all situations from the low, ill-drained ground between the hills to the tops of the highest eminences." In place of these kettle holes peat bogs have taken the place with their decaying plants and the remnants of a boreal flora. The largest of these that I examined occurs in the northwest part of Cerro Gordo and the southwestern part of Worth counties. It covers a considerable area and is an ancient lake bed.

CLIMATOLOGY.

Climatic factors are important in determining the character of the plants found in any given locality. Not only the temperature of the air, the precipitation, the humidity, but the temperature of the soil. Prof. Ganong[2] in an admirable paper on the vegetation of the Bay of Fundy, "Salt and Dried Marshes," takes account of the climatic factors. Schimper, in his great work "*Pflanzengeographie auf Physiologischer Grundlage*," recognizes temperature, light and air as important factors. Nicholas Whitford,[3] in his paper, regards the climatic factors as important in connection with the development of the forest. This subject many years ago was discussed admirably by Dr. Gray in a paper on Forest Geography.[4] The subject is also discussed by Transeau, "On the Geographic Distribution and Ecological Relations of the Bog Plant Societies of North America."[5]

Clements and Pound, in their Phytogeography of Nebraska,[6] discuss the climatic factors. The writer, in his paper on "The

1. Ia. Geol. Surv., 7: 133.
2. Bot. Gazette, 36: 161, 280, 303, 429.
3. Bot. Gazette, 31: 290.
4. Am. Jour. Sci. and Arts, 16: 85. 1878.
5. Bot. Gazette, 36: 401.
6. Pro. Ia. Acad. Sci., 9: 15. Cont. Bot. Dept. I. S. C., 21.

Physiographical and Ecological Flora of Western Iowa," has shown that climatic conditions are important in considering the peculiarities of the loess flora of western Iowa. Finally, there is a full discussion of the climate and the flora of Mt. Katadin by

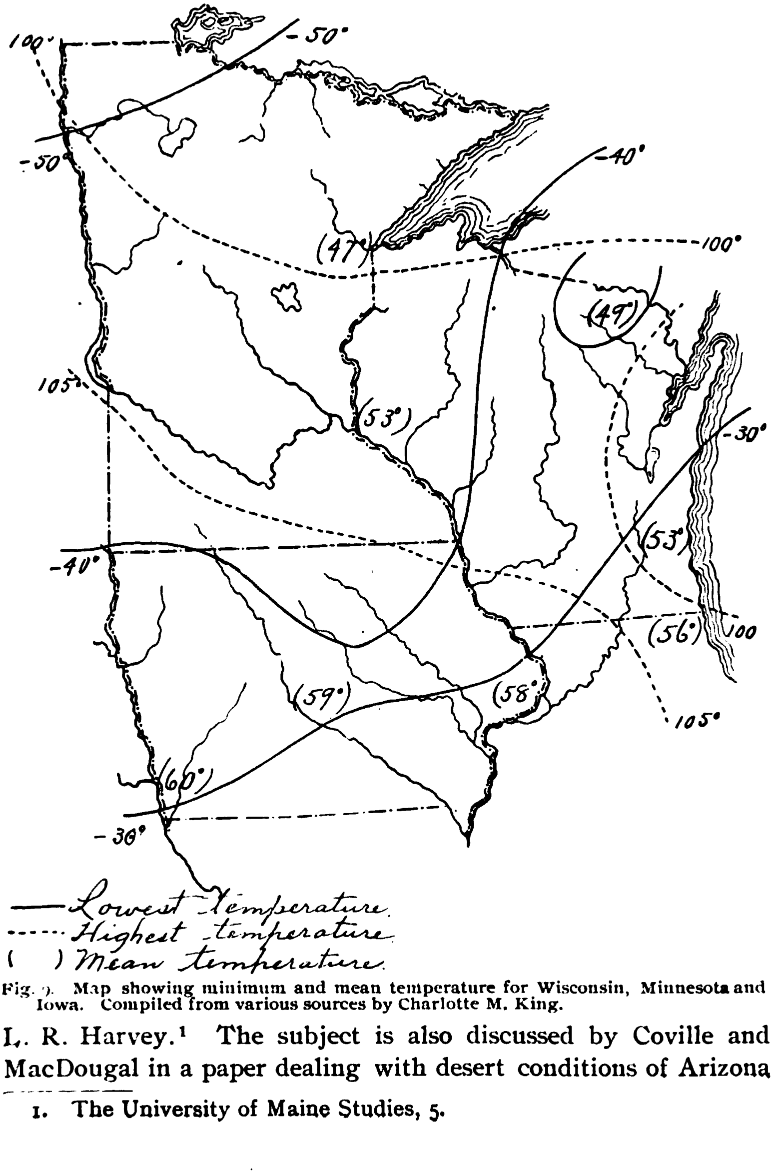


Fig. [illegible]. Map showing minimum and mean temperature for Wisconsin, Minnesota and Iowa. Compiled from various sources by Charlotte M. King.

L. R. Harvey.[1] The subject is also discussed by Coville and MacDougal in a paper dealing with desert conditions of Arizona

1. The University of Maine Studies, 5.

in which they call attention to the great importance of climatic factors.[1]

The velocity of the wind seriously affects the transpiration of water from plants.[2] This is more marked in central Iowa than in western Wisconsin. It is certainly very marked in western

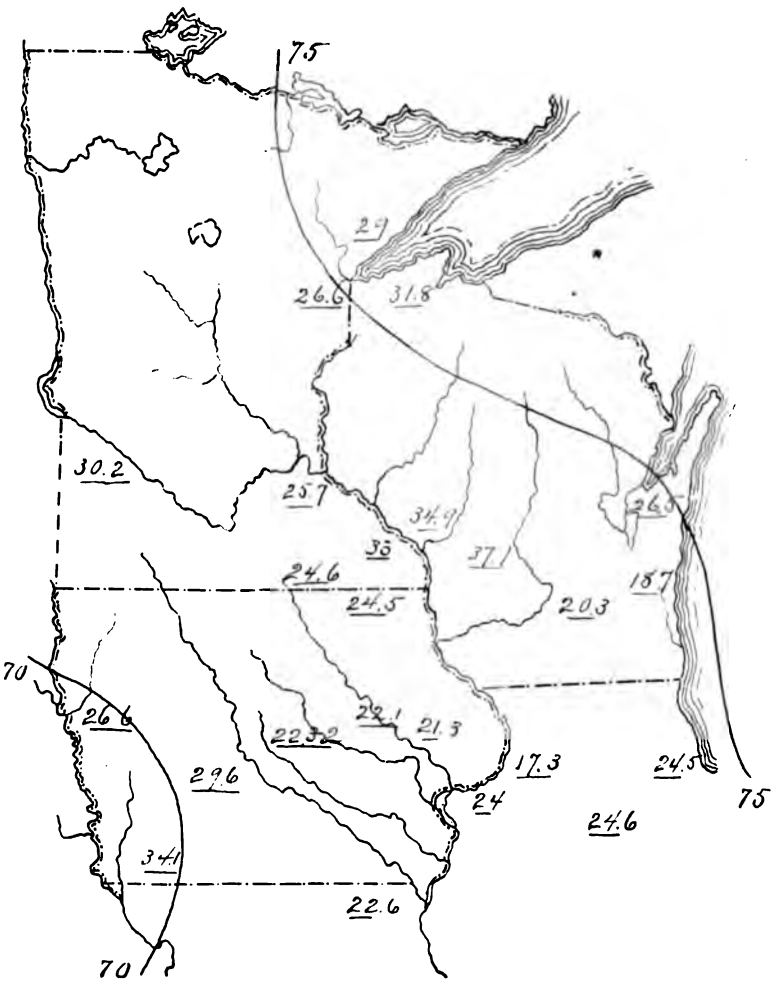


FIG. 10. Map showing normal annual humidity and precipitation for the year 1901; the lines indicate the normal annual humidity, and the figures the precipitation for 1901, a dry year. Compiled from various sources by Charlotte M. King.

1. Desert Laboratory of the Carnegie Institution, 6.
2. Contr. Bot. Dept. I. S. C., 21. Pro. Iowa Acad. Sci., 152.

Iowa, where many of the plants occurring on the loess soil are protected by their thick leaves and pubescence.

For the sake of convenience we shall discuss the subject of climatology under the heads of (1) Precipitation and Temperature of the Different Regions and (2) the Soil Temperatures and (3) Phenology.

Precipitation and Temperature. The time of precipitation and a high mean temperature during the growing period are important in determining the success of an agricultural crop. The same factors apply to many native plants which develop but slowly during the early spring months but attain their best growth when the maximum heat is greater. These plants require long periods of development, as in the Asters, Goldenrods and Thistles. On the other hand, the vernal plants develop at a time when the maximum temperature is much lower, as the Hepatica, Dicentra and Symphoricarpus. Dr. Samuel Weidman[3] gives the precipitation for western Wisconsin for the months of June, July and August from ten to twelve and a half inches; mean temperature for July, 70°; the May mean temperature, 56°; precipitation for March, April and May, 6.5-9 inches; mean temperature for September, 61°; precipitation for September, October and November, 8.5-9 inches; the mean precipitation for December, January and February, 3.5-5 inches; mean temperature for January, 15°.

CLIMATOLOGY AT SEVERAL DIFFERENT STATIONS IN THE STATE OF IOWA.

For the purpose of presenting the more important points the following tables are given, showing the climatology for these points: Lansing in northeastern Iowa, Ogden in central Iowa, Muscatine in southeastern Iowa, and an annual meteorological summary for La Crosse, Wisconsin.

3. Wis. Geol. Surv., and Nat. Hist. Surv., 11: 491.

CLIMATOLOGY OF LANSING, IOWA. MEAN TEMPERATURE (DEGREES).

YEAR.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1896						70.5	72.4	71.0	57.9	47.4	32.0	28.2	
1897	17.3	25.2	30.6	48.8	57.9	67.6	75.0	67.8	68.7	57.0	31.2	18.2	47.2
1898	23.4	23.3	37.6	47.0	61.3	71.0	72.6	70.0	65.2	48.2	34.0	17.6	47.6
1899	18.5	12.2	23.7	50.2	60.3	69.5	73.2	71.9	61.9	57.0	44.2	21.8	47.0
1900	24.7	14.9	29.6	51.8	63.4	69.2	72.3	77.6	65.0	58.8	32.6	26.8	48.9
1901	22.6	15.8	33.0	51.4	61.5	71.8							
1902				48.4	63.0	65.6	73.0	68.6	60.1	52.8	40.9	20.4	
Average	21.3	18.3	30.9	49.6	61.2	69.3	73.1	71.1	63.1	53.5	35.8	22.1	47.7

LANSING, IOWA. MEAN PRECIPITATION (INCHES).

YEAR.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1896						4.97	1.64	3.07	4.01	2.45	3.20	0.45	
1897	2.82	0.94	1.70	2.24	0.94	6.53	2.65	1.40	3.03	0.26	0.81	1.22	24.55
1898	0.85	1.70	2.37	3.03	2.38	3.00	3.12	2.37	2.64	5.20	1.93	0.27	28.86
1899	0.53	1.77	2.68	4.12	3.87	6.01	1.11	5.00	1.57	1.27	1.75	2.65	32.23
1900	1.05	1.14	1.69	2.84	4.35	2.03	5.28	3.02	3.55	4.62	1.92	0.37	31.86
1901	0.66	1.08	3.73	1.04	2.97	2.63							
1902				1.08	11.36	3.52	6.87	3.18	3.00	1.76	1.75	2.12	
Average	1.18	1.33	2.43	2.39	4.31	4.10	3.49	3.00	2.97	2.59	1.89	1.18	29.40

1. Ann. Rept. Ia. Weather and Crop Service. 1902: 32.

CLIMATOLOGY OF OGDEN. MEAN TEMPERATURE (DEGREES).

YEAR.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1894							81.8	77.1	66.	51.9	31.1	29.3	
1895	14.	17.	35.	54.	61.	69.	70.	73.	68.	47.	35.	25.	47.2
1896	23.9	28.8	31.2	54.4	64.8	70.	73.	72.3	58.6	48.2	29.5	31.6	48.9
1897	19.	25.	33.	48.	59.	69.	75.	69.	72.	57.	35.	17.	48.2
1898	23.	23.	37.	49.	59.	71.	73.	72.	66.	48.	32.	17.	47.4
1899	20.5	13.	24.4	48.2	59.6	70.0	72.0	74.1	63.1	58.8	43.4	21.8	47.4
1900	26.2	13.9	31.7	53.4	63.8	68.9	73.3	75.4	64.6	60.2	32.6	24.5	49.1
1901	22.5	17.	33.6	49.4	61.2	70.7	82.2	73.2	65.0	53.5	35.2	21.2	48.5
1902	23.1	17 6	39.4	48.8	64.0	66.1	73.4	70.2	60.7	55 9	43.3	23.3	48.8
Average	21.5	19.4	33.2	50.5	61.4	69.7	74.9	73.0	64.7	53.4	35.2	23.4	48 2

OGDEN—PRECIPITATION (INCHES).

YEAR.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1894							.01	2.28	2.44	3.82	.26	.98	.
1895	.32	.42	.54	4.13	3.20	5.39	3.41	4.61	2.75	.78	1.74	1.00	28.36
1896	.21	.52	1.00	4.89	9.66	1.70	8.26	2.69	3.82	2.95	1.70	.47	37.87
1897	1.18	.54	1.64	5.24	1.75	1.91	2.13	3.64	3.08	1.32	.29	1.54	24.26
1898	9.2	1.01	2.08	1.46	4.73	5.88	1.69	2.87	3.91	3.91	1.27	.33	30.06
1899	.11	.38	1.36	1.62	7.80	7.21	2.17	3.71	1.25	2.01	1.16	1.65	30.43
1900	.31	1.09	2.09	3.49	4.82	6.30	8.03	8.34	6.86	3.17	.66	.16	45.32
1901	.55	.60	1.61	1.57	2.72	2.76	2.41	1.38	6.87	3.31	.87	1.30	25.95
1902	1.08	.15	1.87	1.23	6.61	7.86	8.87	7.01	3.25	2.69	2.02	1.63	44.27
Average	.59	.59	1.52	2.95	5.16	4.88	4.12	4.06	3.80	2.66	1.11	1.01	32.45

1. Ann. Rept. Ia. Weather and Crop Service. 1902: 93.

CLIMATOLOGY OF MUSCATINE. MEAN TEMPERATURE (DEGREES).

YEAR.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1879	17.7	23.4	36.4	48.8	63.0	68.7	75.3	70.7	58.8	58.9	38.2	20.4	48.6
1880	35.1	30.0	35.1	48.6	65.1	71.1	75.2	72.8	60.6	48.7	27.4	18.6	49.0
1881	11.1	20.1	28.0	42.7	66.6	69.1	75.2	76.7	69.6	54.0	35.1	35.0	43.6
1882	23.6	36.4	41.2	49.5	55.0	69.3	69.6	69.6	62.7	58.8	38.7	23.3	49.8
1883	9.7	19.0	31.4	56.3	56.2	67.2	69.0	68.3	57.3	47.7	38.0	25.5	45.5
1884	10.4	21.1	32.6	46.9	57.8	66.7	69.8	66.9	67.3	55.8	35.8	19.3	45.9
1885	11.1	10.4	31.0	47.6	66.9	68.2	76.5	68.8	65.0	47.6	37.1	19.6	45.8
1886	14.2	21.2	32.4	50.3	61.2	66.2	77.2	75.4	66.4	65.6	33.7	10.6	47.9
1887	12.5	23.4	34.4	50.8	65.0	77.8	78.4	71.8	50.4	47.7	36.4	24.2	47.2
1888	9.6	20.9	30.6	50.8	55.0	63.2	74.2	70.7	59.2	48.5	38.5	31.2	46.0
1889	25.8	21.4	40.2	50.5	59.6	66.9	73.0	70.0	62.0	49.1	36.7	39.6	49.6
1890	26.7	31.5	29.9	52.2	58.8	73.8	75.7	68.9	58.7	50.6	40.8	29.1	49.7
1891	21.5	25.9	29.0		58.6	72.4	67.8	58.5	66.0	51.6		33.8	
Average	20.2	24.7	35.0	46.9	59.8	68.1	73.0	70.5	62.4	50.3	35.1	24.4	47.5

MUSCATINE—PRECIPITATION (INCHES).

YEAR.	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1879	1.20	1.67	2.18	1.81	4.54	3.78	3.40	4.56	2.37	2.85	4.65	1.42	33.83
1880	3.02	1.63	3.62	3.02	3.25	7.12	3.84	4.48	3.17	.25	.97	1.31	35.78
1881	1.34	3.49	2.58	2.11	2.43	0.38	3.77	1.36	6.59	7.03	2.83	1.75	45.16
1882	.84	1.10	2.98	4.00	8.30	8.25	4.55	1.75	1.38	4.29	7.15	2.02	46.07
1883	1.66	4.67	75	5.00	6.19	4.77	4.31	1.45	1.19	6.23	3.45	1.45	41.12
1884	1.05	1.40	4.28	2.08	5.57	4.63	3.63	5.77	5.23	6.4	1.57	4.42	45.49
1885	2.38	2.21	.25	4.07	4.18	4.81	5.03	7.38	2.88	2.80	.83	2.32	39.14
1886	4.21	1.43	4.16	2.62	5.05		.32	2.62	3.05	4.70	.95	.71	
1887	1.88	4.12	1.14	1.26	2.26	2.10	2.50	2.40	3.49	2.24	.98	3.53	28.30
1888	1.49	.70	3.10		6.78	3.82	3.9	7.24	2.00	1.50	4.43	2.84	
1889	1.41	1.38	.65	4.28	4.17	5.68	6.69	1.15	3.95	1.04	1.65	1.40	33.47
1890	1.90	1.70	3.24	1.12	3.61	6.68	1.88	2.35	2.52	4.24	1.38	1.20	31.87
1891	1.75	2.19	3.50		2.51	4.87	3.29	5.20	1.35	1.49		2.51	
Average	1.81	2.08	2.79	3.41	4.38	4.86	3.91	4.38	3.72	3.04	2.30	2.28	39.22

1. Ann. Rep. Ia. Weather and Crop Service, 1902: 128.

ANNUAL METEOROLOGICAL SUMMARY. LA CROSSE, WIS.

Summaries are for Year Ending December 31, 1901.

Mouth.	Mo. Temp.	Relative Humidity 8 a.m.	Precipitation. Inches.	Cloudiness	Total Hours Sunshine Recorded. (Local Time.)
January....	20.6°	81%	.64	6.1	
February...	13.9	81	.64	4.4	
March......	31.0	78	2 16	6.8	
April.......	51.5	66	1.17	5 0	
May.	61.2	73	3.85	4.9	
June........	70.7	80	5.31	4.5	
July........	79.2	73	6.49	3.3	
August.....	72.0	84	.93	2.9	
September..	60.4	86	9 84	5.7	
October....	52.6	83	2.70	4 3	
November..	33 4	79	.74	5.5	
December	18.0	82	.46	6.2	
Average....	4.70	79	34 93	5.0	

U. S. Dept. Agrl., Chief of Weather Bureau, 1901-1902: 102.

ANNUAL METEOROLOGICAL SUMMARY. DAVENPORT, IOWA.

Month.	Mo. Temp.	Relative Humidity 8 a.m.	Precipitation Inches.	Cloudiness	Total Hours Sunshine Recorded. (Local Time.)
January ...	26.6°	86%	1.10	4 9	
February...	15.7	91	1.59	3 4	
March.....	35.8	83	2.57	6.6	
April.......	50.5	74	.88	5.0	
May........	61.3	74	1.37	4.5	
June	74.2	77	3.02	3.3	
July........	83.0	65	1.48	1 9	
August.....	74.2	76	.46	3.4	
September..	65.4	82	2.29	4 3	
October....	55.6	84	.45	3.5	
November..	36.8	82	.79	3 6	
December..	22.8	90	1.33	6 5	
Average....	50.2	80	17.33	4.2	

U. S. Dept. Agrl., Report Chief of Weather Bureau, 1901-1903: 80,

ANNUAL METEOROLOGICAL SUMMARY. DES MOINES, IOWA

Month.	Mo. Temp.	Relative Humidity 8 a.m.	Precipitation. (Inches.)	Cloudiness	Total Hours Sunshine Recorded. (Local Time.)
January....	26.3°	84%	1 01	5.2	166.5
February...	20.0	84	1.11	4.8	181.2
March......	35.8	82	3.02	6.2	181.0
April.......	50 4	78	2.26	5.6	244.0
May........	61.6	75	1.40	4 8	312.7
June........	73.4	78	2.41	4.5	329.1
July........	84.0	68	1.72	3.5	390.1
August.....	75.0	77	.67	4 4	318.9
September..	64.8	83	2.60	5.5	199.9
October....	56.2	81	2.14	4.5	230.0
November..	37.6	80	.40	4.1	212.7
December..	21.9	86	1.03	6.1	144.1
Average ...	50.6	80	19.77	4.9	

U. S. Dept. Agrl., Chief of Weather Bureau, 1901-1902: 82.

SOIL TEMPERATURES.

It has long been recognized that the temperature of the soil is an important factor in plant growth, especially in its relation to the development of plants. In a cold soil or stratum plants are necessarily much retarded in their development; in fact, a cold soil produces a much different plant than a warm soil. This is well illustrated in the plants found in the bogs of Worth county and the plants found on the shady limestone rock in Allamakee county. Dr. MacDougal[1], in a paper on soil temperatures and vegetation, discusses the importance of making such observations. These records, however, should be continued.

Temperature records on the soil in wood and field have been kept for some years at this station but, there is no other data except for a few of the published records and a number of additional observations made since. These are inserted here for the purpose of comparing them with records at other places. For records taken at Boone I am indebted to Mr. Wilson and Mr. Morrow. For the records at Ames I am indebted to Mr. Bourne and Mr. Dixon. The records at La Crosse were made by Louis Pammel.

SOIL TEMPERATURE FOR AMES AND LA CROSSE.

LOCALITY.	Soil.	Date.	At a Depth of Six Inches. 7 A. M.	12 M.	7 P. M.
La Crosse, Wisconsin.	Sandy	May 6	62	64	68
Ames, Iowa...........	Wis. drift	" 6	36	40	42
La Crosse............	Sandy	" 7	62	70	72
Ames.................	Wis. drift	" 7	38	44	47
La Crosse............	Sandy	" 8	58	58	56
Ames.................	Wis. drift	" 8	39	40	41
La Crosse............	Sandy	" 9	50	58	58
Ames.................	Wis. drift	" 9	39	44	42
La Crosse............	Sandy	" 10	46	56	63
Ames.................	Wis. drift	" 10	39	44	46
La Crosse............	Sandy	" 11	54	60	64
Ames.................	Wis. drift	" 11	40	42	47
La Crosse............	Sandy	" 12	53	53	56
Ames.................	Wis. drift	" 12	42	44	47
La Crosse............	Sandy	" 13	52	54	54
Ames.................	Wis. drift	" 13	45	49	50
La Crosse............	Sandy	" 14	48	54	54
Ames.................	Wis. drift	" 14	45	50	52
La Crosse............	Sandy	" 15	38	54	60
Ames.................	Wis. drift	" 15	46	52	54
Ames.................	Wis. drift	Mar. 29-31	31.6	32.6	33.3

1. U. S. Monthly Weather Review, 1903: 379. Repr. Cont. N. Y. Bot. Garden, 44.

SOIL AND AIR TEMPERATURE OF THE LEDGES.

Locality.	Character of Soil.	Date, May 15, 1904.	Temp. of Air.	Temp. of Soil. 1 in.	Temp. of Soil. 6 in.	Exposure.
Ledges, Boone Co.	Sandy.	2:00 P. M.	62°	54	49	Temp. on rock 71°. West slope.*
" " "	Sandy loam.	2:00 P. M.	57	59	50	Knoll 60 feet high, exposed to sun.
" " "	Loamy.	2:00 P. M.	61	56		Bare ground.
" " "	Loamy.	2:00 P. M.		62		Covered with grass.
" " "	Loamy.	2:00 P. M.			52	Bare ground.
" " "	Loamy.	2:00 P. M.			55	Covered with grass.
" " "	Black sandy loam.	2:00 P. M.	62	50	49	Soil covered with dead leaves.
" " "	Sandy loam.	2:30 P. M.	72	60	56	Exposed south side. Eighty feet high.†
" " "	Sandy loam.	2;30 P. M.	62	55	48	West slope.
" " "	Sandy creek bottom.	2:30 P. M.	62	69	61	Covered with grass.
" " "	Sandy creek bottom.	2:30 P. M.	62	55	49	
" " "	Alluvial.	3:00 P. M.	61	60	55	Des Moines Riv. 2nd bottom. Cult. 1903.
" " "	Alluvial.	3:00 P. M.	64	71	57	Des Moines River. Plowed, 1904.

* Ledge 20 feet high.
† Plants 5-6 days in advance of shady slopes.

In the soil temperatures taken a few years ago at Ames it was found that there is a great deal of fluctuation even in the summer at the depth of from one inch to a foot, but at three feet there is little variation. The amount of covering also influences the temperature of the soil. In 1892 soil temperatures, as well as the temperature in oats and a patch of bachelor's button, were kept during the months of May, June and July.[1] The temperature in the oat field or in the bachelor's button were uniformly lower than the temperature of the air. The table on the following page will show the difference.

1. Bull. Ia. Agr. Exp. Sta., 18: 488.

METEOROLOGICAL RECORD, AMES, IOWA.

Date.	Mean Temp. of the Air.	Precipitation.	Date.	Mean Temp. of the Air.	Precipitation
May 13	50.6	2.86	June 29	67.6	
" 24	64.3		" 30	61.3	
" 25	62.		July 1	66.	
" 30	67.		" 2	71.7	
" 31	52.		" 14	78.8	
June 1	49 3	3.74	" 15	71.8	
" 2	55.6		" 30	71.7	
" 14	71.3		" 31	72.	
" 15	77				

RADIATION THERMOMETER IN OATS.

Date.	Minimum.	9 A. M.	12 M.	5 P. M.	Mean.
May 13	28		62	56	48.6
" 24	47	74	65	73	64 7
" 25	41	76	78	69	66
" 30	46	65	78	70	64.7
" 31	48	50	49	50	49 2
June 1	44		47	44	44.6
" 2	44	66	61	78	62.2
" 14	51	65	71	66	63 2
" 15	51	70	75.5	79	68.8
" 29	49.5	62	73	69	64.3
" 30	45	60	70	64	62.2
July 1	41		66	62	56.3
" 2	54	66	63	67	62.5
" 14	57	73	82	79	72.7
" 16	50	64	68	75.5	62.1
" 30	46	65	73	65	62.2
" 31	52	68	74	63	64.

PHENOLOGICAL DATA.

The time of blooming of a good many plants has been kept at Ames for a number of years.[1] Notes on a few plants are inserted here. These data have been collected by Miss Charlotte M. King.

PHENOLOGICAL TABLE.

	Time of Blooming.				
	1896	1901	1902	1903	1904
Acer nigrum	4–26	4–29	4–26		5–15
Acer saccharinum		3–23	4–11	3–17	4–2
Æsculus glabra		5–3	5–11	5–7	
Aster lævis			5–5		
Aster novæ-angliæ			8–20		
Astragalus canadensis			8–20	7–10	
Cratægus mollis		5–3	7–18	5–13	

1. Report Iowa State Hort. Soc., 36: 114; 37: 131; 38: 113.

	Time of Blooming.				
	1896	1901	1902	1903	1904
Cratægus punctata.					6-2
Gentiana andrewsii.				9-15	
Gentiana quinqueflora.				9-10	
Gerardia tenuifolia.			8-20		
Geranium maculatum		5-9	5-11	5-12	5-13
Helianthus grosse-seratus					7-28
Heliopsis scabra			6-5		
Isopyrum biternatum.		4-23	4-19	4-17	4-20
Lilium canadense.				7-10	
Lilium philadelphicum.			6-19	6-23	6-16
Lobelia cardinalis.				8-18	
Lobelia syphilitica.				8-28	
Melilotus alba.				6-28	
Monarda fistulosa.					7-19
Negundo aceroides.	4-10		3-19		4-27
Phlox divaricata			4-28	4-23	5-4
Phlox pilosa.			5-9	5-22	6-5
Physocarpus opulifolius.		6-1		5-28	6-10
Podophyllum peltatum.		5-19	5-4		5-15
Prunus americana.	4-19	4-24	4-27	4-17	5-8
Prunus virginiana	5-8	5-7			5-12
Pycnanthenum lanceol'm.					7-18
Pyrus Ioensis	5-2	5-6	5-9		5-8
Pyrus prunifolia.		4-27		4-29	
Ranunculus abortivus.			4-26	4-16	5-3
Ranunculus septentrion's.				4-18	5-4
Solidago latifolia,				8-11	
Solidago missouriensis.					7-20
Solidago rigida.		8.20	8-28	8-8	
Taraxacum officinale.		3-24		4-7	4-6
Trillium nivale.	4-17			3-17	4-3
Verbena hastata					7-22
Veronica virginica.				7-10	
Vicia americana.			5-31	5-19	5-24
Vitis riparia.	5-1	5-18	5-24	6-1	6-10

TIME OF BLOOMING OF PLANTS FOR 1904.

	Locality.			
	Lansing.	Ames.	Elkader.	Davenport.
Anemone thalictroides	5-10	4-22	5-2	4-27
Aquilegia canadensis	5-14	5-13		5-14
Arisæma triphyllum	5-14	5-5	5-27	5-12
Capsella bursa-pastoris	5-9	4-10	4-27	5-2
Claytonia virginica	5-5	4-17	5-3	4-25
Cratægus mollis	5-14	5-6	5-22	5-12
Dicentra cucullaria	4-25	4-17	4-27	4-20
Erythronium albidium	4-30	4-28	5-2	4-27
Geranium maculatum	5-14	5-13	5-14	5-10
Podophyllum peltatum	5-14	5-15	5-22	5-14
Prunus americana	5-5	5-3	5-4	5-7
Ranunculus abortivus	5-7	5-3	5-15	4-30
Ranunculus septentrionalis	5-9	5-4	5-15	
Ribes aureum	5-7	5-5	5-5	5-2
Taraxacum officinale	5-1	4-6	4-27	4-3
Tradescantia virginica	5-25	5-18	6-6	5-30
Uvularia grandiflora	5-6	5-3	5-10	4-27
Viola cucullata	5-1	5-3	5-10	5-7
Viola pubescens	5-7	5-3	5-14	5-7

PHYSICAL AND CHEMICAL PROPERTIES OF SOME TYPICAL SOILS OF THE REGION.

Physical.—The physical character of the soil influences in a marked degree the kind of native vegetation found in the same. Several reports and papers issued by the Bureau of Soils of the United States Department of Agriculture have discussed some of the problems. The Bureau of Soils[1] has carried on some elaborate field investigations and in some instances the work has been applied to the native vegetation. Some interesting work has been carried on by Means and Holmes.

Kearney has given some attention to the study of soil production, and the growth of plants, in alkaline solutions. The question of alkalies and the growth of special plants has been made a subject of papers by Davie and Loughridge.[2] There are not many alkali spots in Iowa. Some of the old lake beds in Northern Iowa show alkali which consists chiefly of magnesium car-

1. Field Operations of the Divison of Soils. 1902: 333.
Milton Whitney. Field Operations of Division of Soils. 1900. 2: 274.
Milton Whitney. Field Operations of the Bureau of Soils. 1901: 3: 647. 95 pl.-25f-31 maps.
Whitney. Soils in Their Relations to Crop Production. Yearbook U. S. Dept. of Agriculture. 1894: 129.
2. Report U. of California Agri. Exp. Sta., 1895-7. Separate 24.

bonate. This substance forms a white crust on the surface. There is here a poor growth. The *Hordem jubatum* thrives, *Scripus palustris* and *Polygonum Muhlenbergi* make but feeble growth in some old lake beds. *Rumex martimus*, *Scirpus pungens* and *Triglochin* occur. Our soils are usually so well leached that few of these halophytes grow.

Some of the more important plants found in certain alkali soils of the west, like the *Sporobolus airoides*, *Scirpus maritimus*, *Distichlis apicata*, are not found in Iowa though they occur in Nebraska. It has been found by Davie that the Creosote bush, and the Larrea, the *Sporobolus airoides*, and *Distichlis spicata* are confined to special areas.

The physical problems of the soil have long been studied by Dr. Hilgard[1] and no one is more familiar with these problems than he.

Several interesting contributions have been made by Dr. Hilgard, Profs. Loughridge, Snow and Shaw[2] especially on the physical problems connected with the soil and crop production. Attention should also be called to the excellent work by Warrington.

Dr. Ganong has applied some of the problems to a province of the Bay of Fundy Salt Marshes in the Provinces of New Brunswick and Nova Scotia. The Bay of Fundy marsh soil, according to Dr. Ganong, contains but a small amount of clay in comparsion with silt and fine silt. This soil when exposed to the sun becomes very hard, making it difficult for germinating seeds to push their way through. These conditions do not prevail in any of our soils except locally. There is nearly always enough sand to make the soil capable of good areation.[3]

In order to touch our local problems, Dr. J. B. Weems and Mr. C. E. Ellis have kindly made, for the writer, physical examination of some typical virgin soils in Central Iowa and Western Wisconsin. The soils studied here are from widely varying conditions. The first series of analyses are from soils in Boone County, the ledges. The remainder from La Crosse, Wis.

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1. U. S. Tenth Census Report. Cotton Production of the U. S. Various papers in Rep. U. Calif.

2. Lectures on Some of the Physical Properties of Soil. Oxford. 1900. Many other works, like Storer's, dealing with agriculture and some of its relations to chemistry.

3. Bot Gazette, 36: 280.

MECHANICAL ANALYSIS OF SOILS FROM LEDGES. BOONE, IOWA.

	I. Top of the bluff where Populus grandidentata and Quercus alba grow.	II. Where the Reindeer Lichens, Polytrichium juniperium and Polygala senega grow.	III. From the sandy rock where Polypodium vulgare and Mittella grow. Soil dry.	IV. Bottom soil near river. Contains much alluvium. Where Elymus virginicus and Leersia virginica grow.
Coarse gravel	1.1 %	1.1 %		
Fine gravel	4.63	.04	.34%	.40
Coarse sand	2.1	.08	1.10	.55
Medium sand	3.14	.40	12.10	1.85
Fine sand	13 54	7.11	55.82	25.18
Very fine sand	38.84	57.81	12.53	42.79
Silt	11.70	11.03	5 84	9.61
Fine silt	20.89	18.34	8.83	11.80
Clay	1.54	1.14	.70	1.05
Moisture	.69	.51	.10	1.01
Organic matter	3.19	3.55	2.75	5.99
	100.17	100 01	100.11	100.23

The La Crosse soils* are similar to those occurring in northeastern Iowa. They have been selected to show the types of native plants found there. The Tamarack soil originally contained more humus, but by repeated washings has received some sand from tilled soil near by.

MECHANICAL ANALYSES OF LA CROSSE, WISCONSIN, SOILS

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8
Coarse gravel								
Fine gravel	.93	.05	.19	.75	15.11	.24	6.38	3.88
Coarse sand	.75	.04	.24	.60	7.78	.26	4.65	1 49
Medium sand	1 12	.05	.64	.87	9.49	.46	6 80	2.80
Fine sand	5.42	.40	9.41	4 55	27.22	6.52	31.27	11 86
Very fine sand	17.68	10.57	49 96	50.99	22.76	38.83	27.82	26.16
Silt	23.32	27.20	22 52	22.89	5.25	17.26	7.38	13.75
Fine silt	14.98	19.53	11.09	9.39	9 56	25.61	11.02	29.62
Clay	.81	1.20	1 87	1.28	.78	1.46	.98	3.19
Moisture	5.60	7.01	1.73	1.69	.46	3.09	.77	2.00
Organic matter	29.42	33.90	5.34	7.34	1.66	6.38	3.00	5.25
	100.03	99.95	99 99	100.35	100.07	100.11	100.02	100 00

No. 1 is a peaty soil. The following plants are found on this soil: *Saxifraga pennsylvanica*, *Cornus stolonifera*, *Caltha palustris*, *Habenaria psychodes*, *Bromus kalmii*, *Lilium canadense*, *Symplocarpus fœtidus*, *Carex* sp.

*The La Crosse soils were collected by my brother, H. Pammel, and my father, while the soil from the Ledges was collected by Mr. C. E. Ellis, who made the chemical analysis of the soils.

No. 2. An agricultural soil, black sandy humus. *Quercus rubra*, *Q. alba*, *Carya alba*, *Cypriepedium pubescens*, *Panicum macrocarpon*, *Bromus ciliatus*, *Phlox divaricata*, *Corylus americana*, *Festuca nutans*, *Cystopteris fragilis*.

No. 3. Yellow clay on agricultural soil, excellent for small grain and tobacco. *Anemone nemorosa*, *Quercus alba*, *Q. tinctoria*, *Ranunculus fascicularis*, *Phlox divaricata*, *Sanguinaria canadensis*, *Comandra umbellata*, *Polygala senega*.

No. 4. Sandy brownish-black. St. Croix sandstone mixed with humus. *Betula papyrifera*, *Physocarpus opulifolius*, *Dodecatheon media*, *Campanula rotundifolia*, *Aquilegia canadensis*, *Melica mutica*, *Pellæa gracilis*, *Woodsia obtusa*, *W. ilvensis*, *Vaccinium pennsylvanicum*.

No. 5. Brownish sand, St. Croix, little humus. *Betula papyrifera*, *B. lenta*, *Quercus tinctoria*, *Pinus strobus*, *Juniperus virginiana*, *Helianthemum canadense*, *Potentilla argentea*, *Woodsia obtusa*, *W. ilvensis* (dry), *Pellæa gracilis*, *Phegopteris dryopteris*, *Vaccinium pennsylvanicum*.

No. 6. Peaty, wet and mucky. Taken from Tamarack marsh with considerable drift material containing sticks, leaves, cones, etc. *Larix americana*, *Cornus stolonifera*, *Cypripedium spectabile*, *Calamagrostis canadensis*, *Potentilla palustris*, *Maiantherum canadense*, *Caltha palustris*, *Nemopanthes fascicularis*, *Glyceria arundinacea*, *Saxifraga pennsylvanica*, *Viola blanca*, *V. canina* var. *Muhlenbergii*.

No. 7. Sandy soil. St. Croix sand, much coarse gravel and ancient bed of the Mississippi River. A poor agricultural soil. Contains a small amount of moisture. Crops mature rapidly. Suited for early vegetables. Contains little organic matter. *Talinum teretifolium*, *Helianthemum canadense*, *Tephrosia virginiana*, *Cenchrus tribuloides*, *Prunus pumila*, *Cyperus schweinitzii*, *Œnothera rhombipetala*, *Potentilla argentea*, *Oxalis corniculata*, *Hedeoma hirta*, *Delphinium azureum*.

No. 8. Yellow clay similar to No. 3, supporting a somewhat similar vegetation.

These sandy soils have some points of similarity to the soil from the ledges. They support a somewhat similar vegetation. The soil from the ledges is of a much later geological origin.

Chemical.—Several European investigators have discussed the subject of the chemical conditions of the soil with reference to the poorly developed plant forms in bogs.* Ganong† reports on the chemical analyses from the marsh well of Cornwallis Valley, Nova Scotia. The fertility of the marshes is due to the necessary mineral and organic constituents present to produce good crops being present in an unusually large amount, and are in an immediately available form. He then devotes considerable attention to the sodium chloride in some soils and its relation to the growth of plants.

* Nillson. *Einiges uber die Biologie der Schwedischen Sumpfpflanzen.* Bot.-Cent. 76: 9.
† Ganong. Bot. Gazette. 36: 285.

CHEMICAL ANALYES OF SOME SOILS.

		Insoluble residue	Soluble silica	Alumina Al_2O_0	Ferric oxide Fe_2O_3	Lime CaO	Magnesia MgO	Sulphur trixoide $3O_3$	Phosphor. pentoxides P_2O_5	Soda Ma_2O	Potash K_2O	Moisture	Loss on ignition	Total per cent.
No. 1.	Top of bluff at Ledges, Boone	90.34	.05	2.24	2.16	.57	.39	.11	.13	.36	.26	.69	3.19	100.49
No. 2.	Ledges where lichens grow, Boone	88.17	02	2.26	3.60	.48	.55	.03	.12	.27	.28	.51	3.55	100.04
No. 3.	Top of rock where moss grows, Boone	92.97	04	.28	3 00	.96	.33	.10	.15	.18	.19	.10	2.71	100 01
No. 4.	Bottom soil near D. M. River, Boone	83.75	.03	2.10	1.72	3 04	1.41	.08	.25	.36	.26	1.01	5.99	100.00
No. 5.	Yellow clay, Ledges, Boone	84.12	.05	3.16	3.20	.76	.42	.08	.17	.34	.32	2.04	5.21	100.32
No. 1.	Peat, La Crosse, Wis	58.35	05	2 41	2.40	1.51	.75	.25	.22	38	.21	5 35	28.07	99.95
No. 2.	La Crosse, Wis	48.17	.05	1.99	2 88	4.26	.81	.42	.44	.27	.11	6.65	33 90	99.95
No. 3.	Yellow clay, La Crosse, Wis	86.14	.03	3.72	3.64	.50	.41	.06	.20	.22	.11	1.74	3.87	100.04
No. 4.	La Crosse, Wis	82 07	03	2.97	2 80	.99	.46	.20	.22	.36	.25	1.69	7.39	99.46
No. 5.	La Crosse, Wis	92 28	.05	1.64	1.84	.69	.32	.20	.22	.35	.19	.42	1.80	100.00
No. 6.	Boggy peat, La Crosse, Wis	82.52	.01	4.08	2.72	.7	.68	.07	.19	45	.13	3.05	5 68	100 31
No. 7.	La Crosse, Wis	88.01	.02	.97	2.24	2.48	1.23	.11	.22	.54	.12	.90	3.17	100.01
No. 1.	Earle Buchanan (E. G.)	70.25	03	2.73	1.84	4.24	1.16	.34	.20	.37	.24	2 84	15.73	99.99
No. 2.	Earle Buchanan (E. G.)	82 22	.04	3 44	2.08	.62	.44	.14	.39	.35	.12	1 72	8 54	100.10

BACTERIOLOGICAL ANALYSES OF SOILS.

Two recent papers discuss the bacteria found in American soils. In a paper published by Dr. Mayo and A. T. Kinsley of the Kansas Agriculture Experiment Station the number of bacteria found in the sandy loam, in which native buffalo grass was growing, was estimated at 143,000, and the numbers in black loam, in which Alfalfa and Clover were growing was estimated at 21,091,000. A paper by Prof. Frederick D. Chester of Delaware gives the following table to show the relation of numbers of bacteria in the soil to ammonifying and acidifying efficiency:

Soil.	Total number of bacteria per gram dry soil.	Total amonifying efficiency	Total acidifying efficiency
Experiment Station Garden.......			
1st analysis..................	3,130,000	13.75	2.22
2nd analysis..................	1,294,000	2.48	1.81
Murray Soil, Viola................	250,000	2.13	0.69
Killen Soil, Felton................	540,000	8.90	0.58
Detrich Soil, Chestnut Hill........	4,040,000	26.68	8.57

It is not my purpose here to consider the copious literature on the subject, nor have we attempted to study the subject of nitrification in connection with the soils under consideration. I am indebted to Mr. E. B. Watson and Mr. H. Ness, two special students in the botanical laboratory, for a brief study of the bacteria of some typical Iowa soils.

SOILS FROM BOONE COUNTY.

Locality.	Bacteria per Gram.	Time of Collec'n.
Sandy loam in forest..................	626,420	April 15, 1904
	1,038,078	
Average........................	832,244	
Sandy loam, Reindeer lichen formation	31,907	April 15, 1904
	42,485	
Average........................	37,196	
Polytrichum formation on moist rock..	3,592 030	April 15, 1904
	288,950	
Average........................	1,950,490	
Sandy bottom........................	2,560,516	April 15, 1904
	640,124	
Average........................	1,600,320	
Clay soil............................	409,024	April 15, 1904
	531,263	
Average........................	470,143	

SOILS OF LA CROSSE, WISCONSIN.

No.	Nature.	Bacteria per Gram.	Per Cent of Acid Bacteria.	Time of Collecting.
1.	Peat	1,410,000	20	April 29, 1904
2.	Black soil	2,332,000	10	" " "
3.	Clay	2,008,000	25	" " "
4.	Black soil	834,000	25	" " "
5.	Yellow sandy	375,000	0	" " "

PEATY SOILS OF FRANKLIN COUNTY, IOWA.

No.	Nature.	Bacteria per Gram.				Time of Collecting.
1.	From surface	2,467,450				March, 1904
2.	" "	2,940,000				" "
3.	" "	3,937,000				" "
4.	" "	4,725,000				" "
	Average	3,517,362				
1.	From inner portion	27,500	0	28,894	8	Mar., '04
2.	" " "	29,000	1,687	116,052	0	" "
3.	" " "	1,250	5,625,000	492,364	0	" "
4.	" " "	2,500	8,872	746,052	2,140,625	" "
	Average	15,312	1,408,889	345,813	535,156	

Average of all plates.........576,300

It will be seen from these results that a very large number of organisms appear in all of the soils, and that a great percentage of the species, especially in La Crosse soils, are acid producing, the largest number of organisms being found in the black, arable soils, while the smallest number of the organisms are present in the sandy loamy soils. They referred some of the species to the following: *Bacillus albus*, which, in addition to the characters given, had the property of reducing nitrates to nitrites; *Bacillus delicatulus*, or perhaps the *B. venenosur liquefaciens*, also reducing nitrates to nitrites. It is believed by Dr. Vaughan that the *B. venenosus* is pathogenic. It has been found in water supplies. These organisms were found in peat. In the black soil the organisms appear to be *Bacillus rubescens* and *B. epidermidis*, both reducing nitrates to nitrites. In the clay soil were found *Bacillus venenosus* and in the black soil *Cicrococcus agilis*. The *B. venenosus* only slightly reduced nitrates to nitrites. The *Micrococus agilis* reduces the nitrates very slowly.

The peat soil from the bogs of Franklin county contained the following organisms: *Micrococus citreus*, *Bacillus incanus*, *B. albus*, *B. delicatulus*, *B. punctatus*, and *B. venenosus brevis*. All these produced nitrites from nitrates, especially the *B. incanus*.

PLANT FORMATION.

WESTERN WISCONSIN AND NORTHEASTERN IOWA.

Clay Ridge Formation.—The plants of this formation are quite uniform throughout the entire region. Sometimes one or more species of trees may predominate. The flat areas naturally have different species of plants in part than the sunny and shady slopes. Of the trees the most conspicuous on the flat slopes are the oaks (*Quercus alba* and *Q. ruba* and *Q. tinctoria*). The shell bark hickory (*Carya alba*) is widely scattered but never in solid groves. Two poplars are common, (the *Populus tremuloides* and *P. grandidentata*). These species frequently form solid groves. Occasionally the basswood (*Tilia americana*) may be interspersed with the oaks and hickories, but this tree is usually found on the shady, moist slopes where the white and red oak, paper birch, two ironwoods (*Ostrya virginica* and *Carpinus caroliniana*) and pignut (*Carya amara*), two ashes (*Fraxinus sambucifolia* and *F. viridis*) also occur. The common *Pteris aquilina* is abundant everywhere forming a conspicuous feature of the woods wherever the timber has been removed. This fern soon occupies the ground, growing from two to three feet high. In such openings *Potentilla canadensis* and *Fragaria virginiana* are abundant. Formerly in such woods many strawberries were picked for home consumption. The *Apocynum cannabinum*, *Panicum macrocarpon*, *Bromus purgans*, *Calamagrostis canadensis*, *Phlox divaricata*, *Steironema ciliatum*, *Senecio aureus*, *Helianthus strumosus*, *Triosetum perfoliatum* and *Galium boreale*, *Agrimonia eupatoria*, *Geranium maculatum* occupy similar places.

In the shady woods *Panicum macrocarpon*, *Geranium maculatum*, *Anemonella thalictroides*, *Anemone nemorosa*, *Cypripedium pubescens* occur, the Phlox, Geranium, Panicum and Anemonella in greater abundance than the other species. The moccasin flower is widely scattered but never abundant.

Exposed Limestone Flats.—This formation at La Crosse is nearly 600 feet above the flood plain of the Mississippi. These areas do not cover much ground. In their younger stage they have the aspect of a typical prairie vegetation such as occurs in parts of Iowa. The most typical plant is the *Zygadenus elegans*

and *Ranunculus rhomboideus*. On the limestone rocks there are large prostrate masses of *Juniperus virginiana*. The *Campanula rotundifolia*, *Arabis lyrata*, *Koeleria cristata*, *Aquilegia canadensis* are abundant. The most characteristic plant, however, is the Zygadenus which is found only on these flats.

The St. Croix Area.—Immediately below these limestone exposures is a sandy area in many places showing the St. Croix exposures where there has been much weathering. The soil is of a brownish color or it is blackish when it contains much humus. This area is in part treeless, but much of it consists of grassy covered slopes. The remainder is covered with a forest growth. Each of these areas will be considered separately.

Grassy Slopes.—The grassy slopes are made up in large part of grasses of a few species, among these *Bouteloua curtipendula*, *Andropogon scoparius*, and *Koeleria cristata*. Among the more prominent of the early flowering plants the *Viola pedatifida*, *V. pedata*, *Arabii lyrata*, *Phlox pilosa*, *Silene antirrhina*. Later *Ceanothus americanus*, *Delphinium azureum*, *Solidago rigida*, *S. nemoralis*, and *Rosa blanda*. These hills become quite dry late in summer and show little else than the dried blades of the grasses mentioned above.

Tree Covered Slopes.—The most conspicuous of the trees in the upper slopes are *Betula papyrifera*. On the shady slopes *Carpinus caroliniana*, *Ostrya virginica*, *Tilia americana*, *Juglans cinerea*. Lower slope, *Quercus rubra* and *Q. alba*, *Acer nigrum*, *A. rubra*, *Pinus strobus*. The hazel, *Corylus americana*, is common everywhere as are *Prunus americana*, *P. virginiana*, *Pyrus iowensis*. The herbaceous undergrowth consists of *Convolvulus spithamæus*, *Sanguinaria canadensis*, *Panicum macrocarpon*, *Dodecatheon media*, occasionally *Cerastium vulgatum*, *Cypripedium pubescens*, *Viola palmata* var. *Cucullata*, *V. pubescens*, *Geum album*, *Eatonia pennsylvanica*, *Geranium maculatum*, *Podophyllum peltatum*, *Convolvulus spithamæus*, *Asarum canadense*, *Hydrophyllum virginicum*, *Trillium erectum*, *Hepatica acutiloba*, *Anemone nemorosa*, *Arisæma triphyllum* are among the more important of the herbaceous plants. Altitude and situation determine the abundance of one or more of these plants. The Asarum, Trillium and

Arisæma, *Hydrophyllum appendiculatum* occuring in the rich black sandy humus near the bases of the bluffs. The *Acer nigrum* is common only along the west slopes of the Mississippi on the Wisconsin side and east slopes on the Minnesota side of the river. The *Acer nigrum*, however, reaches its greatest development in the Kickapoo valley and its tributaries. In the smaller valleys away from the Mississippi River the species is rare. Such is, however, not the case in northeastern Iowa. The *Acer rubrum* is an extremely rare species along the Mississippi River, only a few trees occurring and these not on the moist, sand-covered slopes as in the Kickapoo valley and its tributaries, but on the border of tamarack marshes. In the Kickapoo valley the moist covered slopes have the following assemblage of plants: *Acer spicatum*, *A. nigrum*, *A. rubrum*, *Diervillea trifida*, *Quercus rubra*, *Q. macrocarpa*, *Q. tinctoria*, *Taxus canadensis*, *Corylus rostrata*, *C. americana*, *Juglans cinerea*, *Tilia americana*, *Tsuga canadensis*, *Pinus strobus*, *Cypripedium pubescens*, *Asarum canadense*, *Trillium erectum*. The *Tsuga canadensis*, *Clintonia borealis*, *Epigæa repens*, *Coptri trifolia* and *Gaultheria procumbens* are very local. The rock in the Kickapoo valley is often on the surface and this largely accounts for the presence of the plants found here. The soil, too, is quite moist, much more so than the deeply eroded valleys along the Mississippi River.

The Lower Clay Slopes.—The kind of vegetation found on the lower slopes depends on the slope and altitude. Towards the upper portion of the region it is often more or less sandy; the further up, the more it has become impregnated with silica. The sunny slopes were in early times covered with both *Quercus macrcarpa* and *Q. tinctoria*, the former species predominating in Wisconsin and Minnesota while the *Q. macrocarpa* becomes more numerous in northeastern Iowa. *Ranunculus fasicularis*, *Cerastium vulgatum*, *Poa pratensis*, *Geum album*, *Silene stellata*, on the shady slopes *Quercus alba*, *Q. rubra*, *Panicum macrocarpon*, *Cypripedium pubescens*, *Poa pratensis*, *Pyrus iowensis*, *Prunus americana*, *P. virginiana*, *Corylus americana*. These slopes in early days were good agricultural lands and were cropped until they were no longer remunerative. They are now largely turned into pasture and meadow lands. On rich soil *Trifolium pratense*, *T.*

repens, *Agrostis alba*, *Poa pratensis*, *Poa compressà*, *Phleum pratense* grow admirably. *Poa pratense*, *Poa compressa* and *Agrostis alba* are excellent soil-binding grasses and hold the loose soil.

The Higher Alluvial Bottoms.—These occur along the streams in small attached areas. Many of the areas along the smaller streams, before they were brought under cultivation, were marshes. The soil is very rich, often consisting of three or four feet of black alluvial soil, brought down from the hills. These alluvial bottoms were covered quite uniformly with trees of the following species: *Acer saccharinum*, *Tilia americana*, *Ulmus americana*, *Populus monolifera*, *Quercus rubra*, *Carya amara*, *Fraxinus viridis*, and occasionally *Juglans nigra*. The *Arisæma triphyllum*, *Helianthus grosse-serratus*, and *Allium tricoccum*. The absence of *Betula nigra* and *Quercus bicolor* is to be noted.

The Mississippi Alluvium.— The alluvium of the Mississippi River consists of detached and broken sandy prairies in places, as on Goose and other larger islands which are not covered with water some years. Other portions are annually covered with water. The latter may again be divided into the wooded areas and small grassy islands and marshes. On the former the more conspicuous trees are *Acer saccharinum*, *Ulmus americana*, *Betula nigra*, *Populus Monifera Quercus bicolor*, scattered, *Fraxinus viridis* and occasionally *Quercus rubra*, and near the mouth of the Root River *Morus rubra* and *Gymnocladus dioica*.

The grassy islands and marshes contain as conspicuous plants *Lobelia cardinalis*, which form great red banks, *Dulictrium spatuaceum*, *Aster tradescanti*, *Poa scratina*, and *Boltonia asteroides*. A large assemblage of other plants will be considered in connection with the vegetation of marshes.

St. Croix Sandstone Ledges.— These ledges contain a large number of interesting plants. Many of the species are very local in their distribution. The kind of plants is largely determined by the altitudes and strata. The lower water-bearing strata consists of fine sandstone with a water-bearing strata from the base of which numerous springs arise. Along the upper slopes *Pinus stroba* and *Texus canadensis*, as well as *Betula lenta*, are conspicuous trees, while close to the springs *Alnus incana* occurs. The

ferns are, however, the most interesting. We have here two species of *Phegoteris*, *P. dryopteris* and *P. polypodioides*, *Lycopodium lucidulum*, *Asplenium Filix-fœmina*, *Aspidium spinulosum* var. *dilatatum*, *Pellæa gracilis*, *Mitella diphylla*, and along the Kickapoo *Sullivantia ohionis*, *Clintonia borealis*, *Epigæa repens*, *Gaul-*

FIG. 11. Top of clay ridge formation with limestone outcrops. *Carpinus ostrya* and *Quercus* on side hills. Photograph by L. H. Pammel.

theria procumbens, *Circæa alpina*, *Cornus circinata*, *Aralia nudicaulis*, *A. racemosa*, *Acer spicatum*, *Œnothera fruticosa* and *Aquilegia canadensis*.

On the dry rock *Woodsia obtusa*, *W. ilvensis*, *Melica mutica*, *Poa nemoralis*, *Arabis lyrata*, *Campanula rotundifolia*, *Danthonia*

spicata and *Vaccinium pennsylvanicum*. Some of these species, like *Vaccinium* and *Woodsia ilvensis*, are quite rare, the former, however, more widely distributed in the Kickapoo valley.

Rocky Limestone Talus.—This talus, as well as the vertical cliffs, contain an abundance of *Pellæa atropurpurea*, *Campanula rotundifolia*, and in moist situations *Dodecatheon media*. The *Camptosorus rhizophyllus* only occurs upon the talus near the base of the hills. *Arabis lyrata*, *Poa pratensis*, *Eatonia obtusata* and *Koeleria cristata* are common as well as *Cornus alternifolia* and *Rubus strigosus*. These two species, however, occur on sandy slopes.

FIG. 12. St. Croix Area. Sandstone rock. Red Cedar in lower part, *Quercus tinctoria* and *Betula alba*. Photograph by Charlotte M. King.

Tamarack Swamps, Bogs and Marshes.—These have many plants in common. The bogs also have some plants in common with the marshes and tamarack swamps, but the number is small compared with those common to the tamarack swamp and the marsh.

The sphagnum bog has quite a number of plants peculiar to it. Sphagnum bogs in the region are very small and few in number. Some of these bogs have disappeared because of the filling up with drift material from the surrounding St. Croix sandstone outcrops. These areas, owing to the removal of the timber and

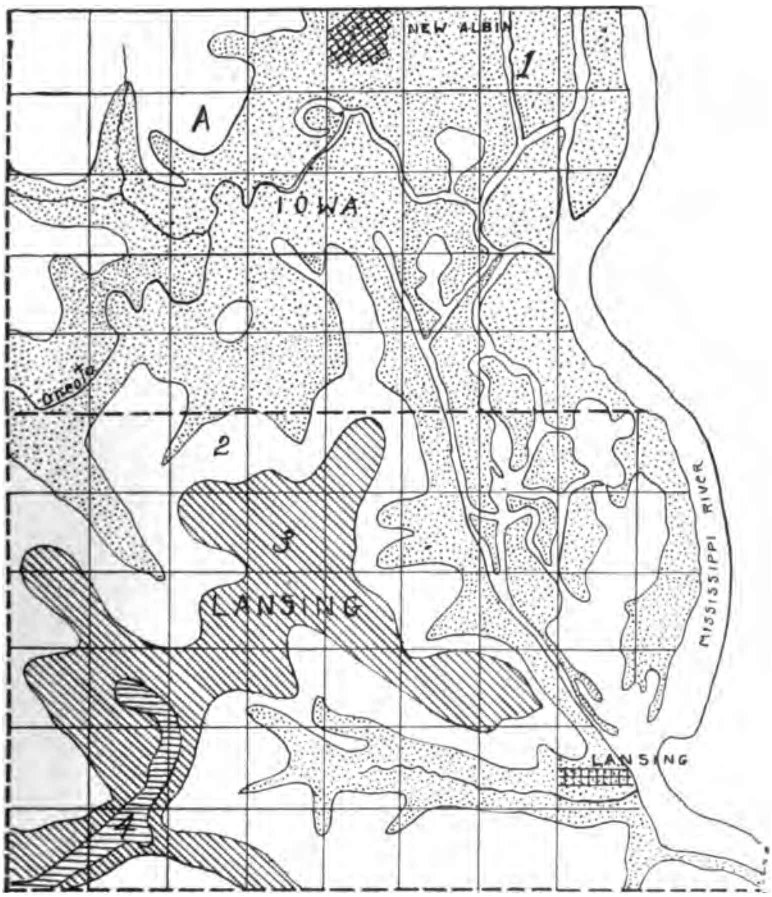


FIG. 13. Topographic Map of Northeastern Iowa. 1. St. Croix. 2. Oneota. 3. St. Peter. 4. Trenton after Calvin.

cultivation of the soil, have washed greatly. In some cases these bogs have been filled with two or three feet of loose drift soil. We will therefore consider the plants under three heads—the tamarack swamp, sphagnum bog and the marsh.

FIG. 14. St. Croix sandstone. *Tilia americana*, *Acer nigrum*, *Quercus tinctoria*, *Acer rubrum*, *Trillium grandiflorum*. Photograph by L. H. Pammel.

Tamarack Swamp.—The term here is used to designate those moist areas in which the *Larix americana* is the most characteristic tree. The Tamarack forms solid groves. No other tree seems to have adapted itself to these areas.* In the north, as in

*For an account of the ecology of the vegetation of our northern woods see the paper of Conway MacMillan, "On the Occurrence of Stagnant Atolls in Central Minnesota." Minn. Bot. Stud. Geol. and Natural Hist. Surv. of Minn. Bull. 9: 2.

N. Whitford. Bot. Gazette, 31: 315.

Observations on the Distribution of Plants Along the Shore of Lake of the Woods. Bull. 9: 949.

the Cass Lake and Leech Lake country in Minnesota, *Abies balsamea*, *Picea nigra* and *Thuya occidentalis* are associated with the tamarack. The *Acer rubrum* is rare in the region close to the Mississippi and occurs only on the margin of the swamp. Of the shrubs the following are quite common: *Rhus venenata*,

FIG. 15. Trunk of Hemlock (*Tsuga canadensis*), Bloomingdale, Wisconsin. Sandy loamy soil. *Cornus circinata*, *Fragaria vesca*, *Gaultheria procumbens*, *Epigæa repens*, *Dierrilla trifida*, *Circæa alpina*, *Pellæa gracilis*, *Smilacina bifolia* on the sandy, moist rock; also *Acer spicatum*. Photograph by L. H. Pammel.

Cornus stolonifera, *Nemopanthes canadensis*, *Betula pumila*, *Ampelopsis quinquefolia*, *Viburnum opulus*, *Juniperus communis*, *Salix candida*, *S. discolor*, *S. rostrata* and *S. lucida*, the *Cypripedium*

spectabile, *C. arietinum*, *Caltha palustris*, *Osmunda cinnamomea*, *O. regalis*, *Aspidium cristatum*, *A. noveboracense*, *Pyrola rotundifolia*, *Valeriana edulis*, *Rubus triflorus*, *Potentilla palustris*, *Coptis trifolia* and *Smilacina trifolia*. The *Saxifraga pennsylvanica*, *Thalictrum purpurascens*, *Lysimachia thrysiflora* and *Caltha palustris* are widely distributed.

FIG. 16. Low sandy alluvium along the Mississippi River near La Crosse. *Acer saccharinum*, *Populus monilifera*, *Fraximus viridis*, *Quercus bicolor*, *Aster Tradescanti*, *Leersia virginica*. Photograph by L. H. Pammel.

Sphagnum Bogs.—The sphagnum is a dominant plant. Equally common is the *Menyanthes trifolia*, which blooms during the month of July. *Sarracenia purpurea* is found nowhere else in the region.

It occurs not only over the bog, but on the margin. Other rare plants in the region are the following: *Rhynchospora alba*, *Pogonia ophioglossoides*, *Calopogon pulchellus*, *Eriophorus virginicum*, *Salix candida*, *Betula pumila*, *Drosera rotundifolia*, *Lobelia kalmii*, *Bidens beckii*, *Cicuta bulbifera*, *Cnicus miticus*, *Parnassia carolinians*, *Os-*

FIG. 17. *Cypripedium spectabile* in Tamarack marsh with *Ampelopsis quinquefolia*, *Cornus stolonifera*, *Larix americana*, *Osmunda regalis* on the ledges of the swamp in sandy wet soil, along with *Osmunda cinnamomea* and an occasional *Acer rubrum*. Photograph by L. H. Pammel.

munda regalis, *O. cinnamomea*. *Pyrola rotundifolia* and *P. elliptica* are found on the shores or on the small hummocks found in the bogs where sufficient soil has accumulated.

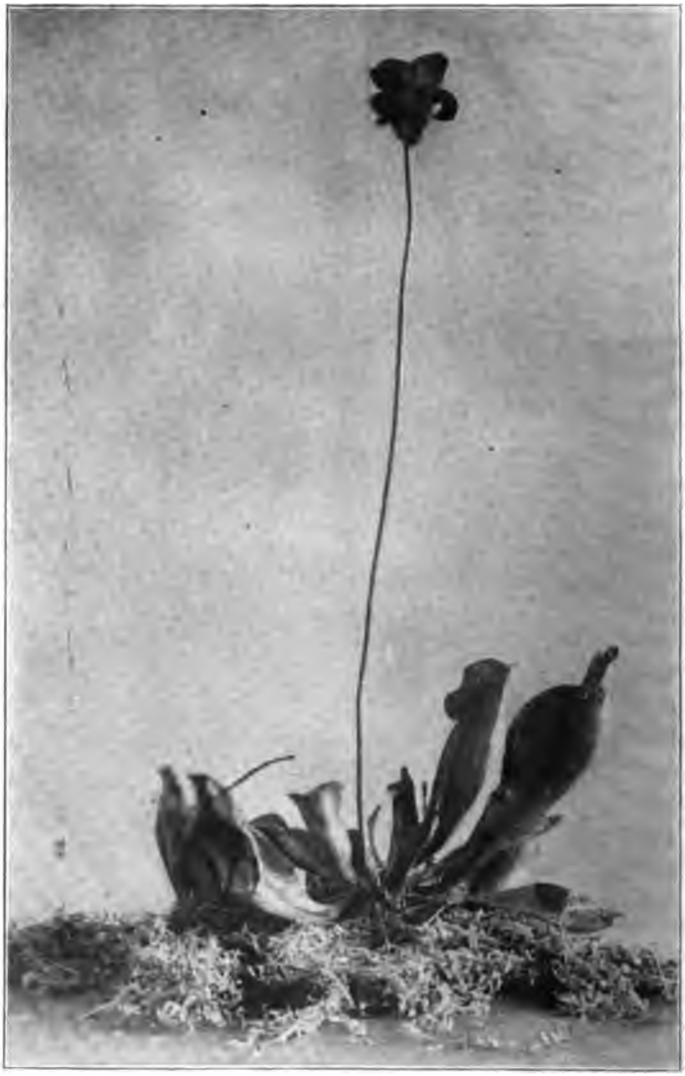


FIG. 18. *Sarracenia purpurea* occurring with *Pogonia*, *Drosera*, and Sphagnum moss in bogs. Photograph by Charlotte M. King.

Wet Marshes.—The marshes are drier than the bogs, still they contain considerable moisture and are wet during the entire year. From these marshes come perennial springs. Where these are of sufficient size they form small streams. These are lined with

several species of willow, like *Salix discolor* and *S. richardsoni*. The *S. candida* and *S. lucida* are confined to the marshes in proximity to the tamarack swamp and sphagnum bog. *Alnus incana* and *Cornus stolonifera* are characteristic shrubs. The *Viburnum opulus* and *Betula pumila* are more restricted in their distribution. *Saxifraga pennsylvanica*, *Thalictrum purpurascens*, *Viola blanda*,

FIG. 19. Edge of Tamarack Swamp in La Crosse County, Wisconsin. *Phragmites*, *Salix lucida* and *Cornus stolonifera*. Photograph by L. H. Pammel.

Iris versicolor, *Glyceria nervata*, *G. arundinaceæ*, *Parnassia caroliniana*, *Lilium canadense*, *Pedicularis lanceolata*, *Lycopus sinuatus*, *Mentha canadensis*, *Stachys palustris*, *Gentiana crinita*, *G. andrewsii*,

Castilleia coccinea, *Heracleum lanatum*, *Valeriana edulis*, *Cnicus muticus*, *Archangelica atropurpurea*, *Conium maculatum*, *Cardamine rhomboidea* and *Bromus kalmii* are common plants of general distribution in these marshes. The *Cypripedium candidum*, *Caltha palustris*, *Viola blanda*, *V. carina* var. *muhlenbergii* and *Symplocarpus fœtidus* are local plants found in proximity to springs.

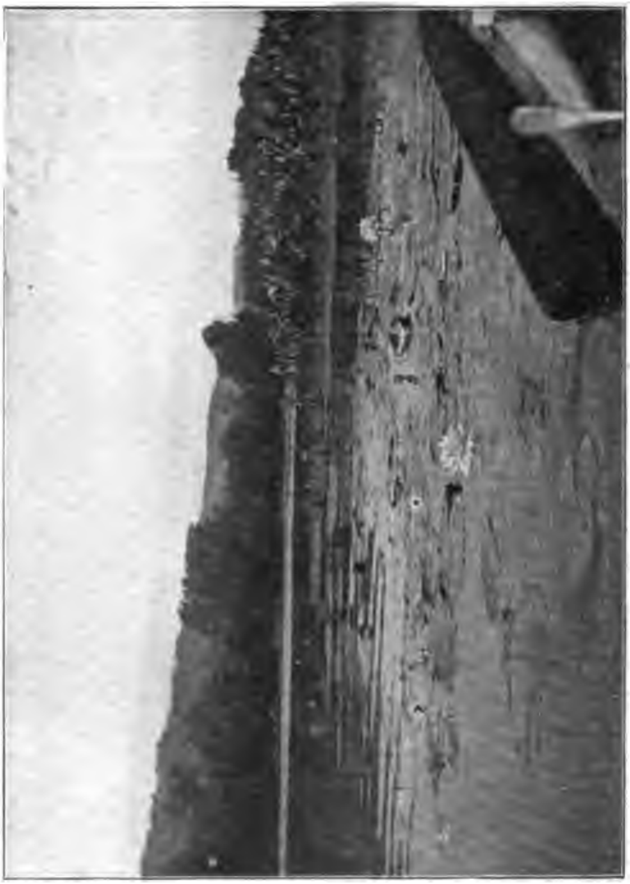


FIG. 20. *Nymphæa tuberosa* in slow-running streams and sloughs near Lansing, Iowa. Photograph by Charlotte M. King.

Alluvial Marshes.—These marshes are often very wet in the spring and influenced by standing water in the spring and early summer. These marshes border the larger streams. They cover much of the area of the Mississippi and Black rivers. Close to

the shore lines of the "sloughs" the *Zizania aquatica*, *Scirpus atrovirens*, *Leersia virginica*, *Dulichium spathaceum*, *Boltonia asteroides*, *Aster tradescanti*, *Sparganium eurycarpum*, *S. simplex*, *Pontederia cordata*, *Alisma plantago*, *Sagittaria variabilis*, *Heteranthera graminea*, *Acorus calamus*, *Typha latifolia*, *Mimulus ringens*, *Lobelia cardinalis*, *Panicum crus-galli*, *Ilysanthus riparia*, *Hemicarpha subsquarrosa* and *Lythrum elatum*. The Lythrum develops ærenchyma along the lower part of the stem, its function being to protect the plant when it becomes immersed.

FIG. 21. Balsam Fir (*Abies balsamea*), *Betula papyrifera*, *Pyrus arbutifolia*, *Corylus rostrata*, *Circæa alpina*, *Quercus rubra*, *Acer spicatum*, *Viburnum opulus*. In open places, *Aconitum uncinatum*. Photograph by L. H. Pammel.

Aquatic Vegetation.—The *Nuphar advena* is widely distributed in ponds and sloughs. The *Nymphea tuberosa* occurs in the small lakes and slow-running sloughs. The *Nelumbo lutea* occurs in a few places also in slow-running water. The *Elodea canadensis* and *Vallisneria spiralis* are widely distributed in ponds and slow-running streams. *Ranunculus multifidus* and *R. aquatilis* var. *trichophyllus*, *Lemna trisulca*, and *L. minor* as well as *Potamogeton*

heterophyllus, *P. natans* and other species are common. The *Mimulus jamesii* is local.

Development of the Swamp.—The region here is peculiar in that there is no evidence of glacial action in the formation of lakes. Inland lakes, or more properly ponds, are of rare occurrence in the region of Minnesota and southwestern and northeastern Iowa under consideration. Away from the streams only a very small number of ponds or lakes occur. The one described here occurs in State Road Coulé and is of comparatively recent origin. The present small creek in State Coulé once had its course along the west side of the bluffs, but by the accumulation of sedimentary material a few miles south cut through an alluvial flood plain, the water sinking away in large part in the loose sandy soil some two miles south of the mouth of the small valley, joining, however, the old channel in time of high water. The accumulation of water from springs at the base of the hills forms a small lake with a marsh of some size at the lower end. Around this lake there occur *Scirpus lacustris*, *Lemna major*, *L. trisulca*, *Elodea canadensis*, *Potamogeton natans* and *Hippuris vulgaris* and *Ranunculus aquatilis* var. *tricophyllus*. The *Spirogyra*, *Zygnema* and *Desmids* are the most important of the hydrophytic plants. On the muddy shore lines *Eleocharis acicularis*, and *E. palustris* and further out the *Acorus calamus*, *Caltha palustris*, and *Symplocarpus fœtidus*, *Iris versicolor* and *Phyragmites communis* form the border of the lake. The ground surrounding the pond is elevated and the vegetation here consists largely of *Glyceria nervata*, *G. arundinacea*, *Phalaris arundinacea*, *Castilleia coccinea*, *Burnus kalmii* and *Campanula aparinoides*, but especially of sedges. The *Scirpus lacustris* and other aquatic plants no doubt were the forerunners of the present marsh vegetation surrounding the pond. *Nuphar*, *Nymphæa*, and *Nelumbo*, aquatic plants of the Mississippi, do not occur. Nicholas Whitford,[1] in describing the development of glacial swamps in northern Michigan, states as follows: "Most swamps start as ponds or lakes, in which water-lilies and other pond plants dominate. On the borders of the pond sedges appear; these, by their decay, build up a soil, and thus prepare the way for the next zone, the Cassandra-sphagnum vegetation. The sedges encroach farther on

1. Bot. Gazette, 31: 313.

the original lake. The Cassandra-sphagnum zone makes conditions possible for a tamarack-spruce zone. Thus each successive zone is pushed farther and farther toward the center. Finally the lily center disappears, and then successively the sedge and Cassandra zones, until a tamarack forest may come to occupy the whole territory."

The bottom of the pond consisted of peat mixture lying on a brown sandy soil. The water is derived from perennial springs. The soil is not typical peat but a mixture of considerable humus and some sand. Two other typical swamp areas may be considered. One, a tamarack marsh in the town of Campbell. This was formed by the accumulation of sand and alluvium at the mouth of the present marsh, where it joins the La Crosse River.

During times of high water this area was filled with water in which aquatic plants probably like *Nuphar*, *Nymphæa*, *Scirpus*, and *Elocharis* formed the principal vegetation. These by decay formed humus which gradually filled the lake and thus gave rise to a bog. As the filling process continued the *Larix americana* made their appearance. Prof. L. H. Harvey[1] in his paper on a study of the physiographic ecology of Mt. Katadin finds in his studies of the sphagnum bog society that the sphagnum advances from the edge, finally the open space is spanned, sufficient soil is formed to permit *Scheuchzeria palustris* to grow; and with more soil *Sarracenia purpurea*, *Vaccinium macrocarpon*, *Smilacina trifolia*. With drier conditions *Eriophorum* and *Carex trisperma* are important constituents. These are followed by *Cassandra calyculata*, *Kalmia angustifolia*, and *K. glauca*. In our bogs we find neither *Kalmia* nor *Smilacina trifolia*. The *Smilacina* is an abundant constituent of the tamarack swamp. The *Vaccinium*, however, is common as *Eriophorum*. The *Picea nigra* is given as the pioneer for the Mt. Katadin bog. Whitford[2] speaks of a tamarack-spruce zone following the Cassandra. Coulter[3] in a paper, "An Ecological Comparison of Some Typical Swamp Areas," refers to the formation of the bogs on North Manitou Island as follows:

"The peat mosses which thrive so luxuriantly in poorly drained conditions are among the pioneer forms concerned in

1. The University of Maine Studies, 5: 43.
2. l. c. 314.
3. Rept. Mo. Bot. Garden, 15: 43.

this process, while the cranberry (*Vaccinium macrocarpon*) quickly follows and soon forms a foothold for the leather-leaf (*Cassandra calyculata*) and allied forms.

"On the land margin the tamaracks and spruces are closely crowding on the shrubs, and back of these, the hemlock-maple-beech forest is encroaching on the conifers."

"The zonal distribution of plants is well illustrated in these tamarack swamps. Within the surrounding forest of maple,

FIG. 22. *Zizania aquatica* on border of wet marsh. Photograph by Charlotte M. King.

beech, and hemlock, the real swamp area is found. The surface of the peaty soil is covered with sphagnum and this zone is dominated by *Larix americana* and *Picea nigra*."

The spruce is absent in western Wisconsin because of climatic conditions, its range being more northward. There are, however, isolated small spruce swamps forty or fifty miles eastward. The arbor vitæ mentioned elsewhere as occurring mixed with tamarack and balsam in northern Minnesota is also more north-

ern in its distribution. However, eastward the species occurs on the St. Croix sandstone along the Wisconsin River associated with *Pinus resinosa*, *P. strobus*, and *Pyrus americana*. Trees frequently follow the courses of streams where they obtain a meager foothold. This is true of the *Quercus bicolor*. The *Acer rubrum*, which to the north and east occurs not only along streams but associated with the white and Norway pine, is in its most western part in Wisconsin found on the border of the tamarack swamp. This tamarack swamp is not only too wet, but the soil condition, probably because of its acidity, is unsuited for the *Acer saccharinum*, *Ulmus americana* and the other alluvial types; hence the line of tension is not so great, permitting the red maple to get a foothold. The tamarack, because of its wide adaptability, occupies a place that no other tree so readily occupies in these marshes. Under cultivation the tamarack succeeds admirably in clay soil everywhere in the region.

These bogs, however, did not form generally in the region. This particular *Larix* swamp and bog lies between low hills. The strata below consists of a fine sand which is highly retentive of moisture and hence made the conditions favorable for the formation of a bog. Adjoining the swamp and in numerous places along the smaller streams are wet marshes which are frequently more or less sloping or but a few feet above the flood plain of the streams and hence, during freshets, covered with water. The sphagnum bog, before the removal of the timber above it, received clear water, but since the cultivation of much of the land above it has become covered with sand to such an extent that its characteristic plants have been obliterated. The *Menyanthes trifolia* is making a vain attempt to persist, *Sarracenia*, *Drocera*, *Eleocharis* and *Pogonia* having entirely disappeared. The *Larix americana* is not common in La Crosse county. The seed was probably carried to the La Crosse River from the country to the north. A second tamarack marsh in La Crosse county occurs in Mormon Coulé, some fourteen miles south. There is no longer a sphagnum bog surrounding or in close proximity to the tamarack grove. The coulé at this point is about one mile wide. The flat area here is wider than at any other point along the creek. The stream is small. A mile below the valley narrows. The soil in proximity to the tamarack marsh is very rich. All evidence seems to show

that we had here an ancient lake which has to a large extent been drained. The region surrounding the grove is still very swampy, but there is no evidence anywhere of a typical sphagnum bog with its accompanying plants like *Sarracenia purpurea*, *Drocera rotundifolia* and *Pogonia*. However, *Salix candida*, *S. lucida*, *S. discolor* and *Aspidium noveboracense* are abundant. The vegetation here is similar to that of the first area here considered. The tamarack swamp is a typical forest island; the seeds were undoubtedly carried by the wind from the La Crosse valley. These marshes are numerously provided with springs and, where there is sufficient fall, form small runs along whose courses the *Salix rostrata*, *Alnus incana* and *Cornus stolonifera* are abundant. As the drainage became more perfect the elevated flat areas bordering on the swamp became covered with shrubs and trees, finally culminating in a growth of trees like *Populus tremiloides*, *Tilia americana*, *Ulmus americana*, *Fraxinus* and *Quercus rubra*.

The Development of Plants on the St. Croix Sandstone.—Some of the slopes are bare of tree forms, as they have been for ages. The location of the slope and altitude are, however, important factors. The bare slopes are peculiar to the region adjacent to the Mississippi River both on the Wisconsin and Minnesota sides of the river. Away from the river these "bald" areas are smaller. The north slopes are generally covered with a tree growth. East and south exposures, as well as some of the southwest exposures, are treeless. Prof. T. H. Macbride[1] accounts for it in this way:—

"North slopes in our latitudes are for only a few months exposed to the sun at all; eastern slopes have the advantage of the dewfall and the coolness of the night before meeting the heat of the morning sun, while the south slopes lie all day long beneath the hottest rays, and the west endures the heat of the afternoon. In the second place, our prevailing winds being from the west, the greatest amount of snow is always lodged on eastern or southeastern slopes. Of all these conclusions Allamakee county shows us a remarkable confirmatory illustration. The observer has but to drive across the country anywhere to discover that the southwestern sides of all the rounded knolls and hills are bare; always have been."

1. Rept. Iowa Geol. Survey, 4: 116.

There has been a remarkable change in the character of the vegetation of these hills within the memory of man. The absence of trees here has been in part accounted for by the prairie fire. It is, however, only one of the causes. Formerly "prairie fires," as they are called, could be seen in all directions during the month of April. They would burn the entire areas except the shaded north and northeast slopes where the snow remained longer and the soil and dead grass was too moist for a good blaze. Since the checking of these fires forest growth has expanded. It has gradually encroached upon some of the bare slopes. In a paper on the forest condition in western Wisconsin the following statement was made:[1] "During the past thirty years some important changes have taken place in the growth of timber along the river. The pioneer settler found little timber on the hills except those with a northern slope. The timber standing on the sunny sides was usually poor in quality, owing to numerous fires. Now these lands are mostly fenced, and fires are kept out, at least by the more enterprising farmers. The bleak hills are being rapidly covered with a forest growth.

"It is not an uncommon thing to observe patches of Hazel (*Corylus americana*, Walt.) beyond the outskirts of the timber; here, in the course of a few years, will be found Oaks, Birches, Hickories, and Poplars. The humus formed where Hazel grows is extremely rich and fertile, and I doubt whether trees could cover our treeless hills very fast without its help."

Since making this statement the region has been visited several times and I have not altered my views. The mesophytic forest has extended and encroached on the grass covered Saint Croix area.

It is evident that such species as *Andropogon scoparius*, *Delphinium azureum*, *Viola pedatifida*, *Lithospermum hirtum* and *Castilleia sessilifolia* are the forerunners for a mesophytic shrub growth, the most important of all these plants being *Rhus glabra*, *Ceanothus americanus*, which appears with the *Andropogon* and *Viola*. The *Rosa blanda* and *Ceanothus* are widely scattered where the *Rhus* forms copses. The *Corylus* shows a long step in advance of the *Rhus;* the collection of a good humus and an abundance of loose soil put it in a good condition for the growth of *Betula*

1. Garden and Forest, 4: 462.

papyrifera, *Prunus americana*, and *Quercus tinctoria*. It is only on the very dry slopes that *Quercus macrocarpa* appears. The older the forest becomes and the more humus and decayed organic matter is found, the more favorable the region becomes for the *Quercus rubra* and *Q. alba*. Occasionally these outlying situations, especially the more moist and lower hill slopes, contain *Pinus strobus*, a tree limited along the Mississippi from La Crosse southward to these sandstone rocks However, in the northern part of this and Trempleau counties the species is common in sandy oak openings. Eastward in the Kickapoo valley it occurs not only in the moister valleys but also along the sandy St. Peter's sandstone ridges. The line of tension between the white pine and deciduous trees is so great along the St. Croix sandstone that it occupies somewhat inaccessible areas.

FIG. 23. Upper part of tree of *Abies balsamea* heavily loaded with cones. Photograph by L. H. Pammel.

Yellow River Region in Allamakee County.—The area about Myron must be considered separately. With Mr. Ellison Orr and Mr. D. O. Wilson, a day was spent early this summer in an investigation of this interesting region. The area here considered is on the north slope of a hill, with the Yellow

River flowing at its base. The Yellow River is a stream of considerable size, having its source from several streams from one-half to three-quarters of a mile above the place where the Balsam Fir occurs. Temperature records taken of the soil one inch down at random indicated that the soil was much cooler than that of the surrounding woody hills and bluffs. The limestone rock is extremely porous and all through it are caverns of various sizes. From these caverns during the summer cold air is constantly issuing. At one point where the rock was covered with mosses, consisting of *Hypnum tamariscinum* and *Anomodon minor*, the temperature was 46°F. The highest temperature found in open places was 63°, at a depth of one inch. At other points the temperature varied from 56° to 60°, showing that one of the most important factors in connection with the boreal plants developed here is the temperature. The temperature of the air was 75°.

The stretch of Balsam Fir woods extends from about one-half to three-quarters of a mile on the north slope of a hill. The Balsam Fir, the White Pine[1], *Pyrus arbutifolia*, *Corylus rostrata*, *Diervilla trifida*, *Betula papyrifera*, *Lonicera glauca*, *Aralia quinquefolia*, *A. racemosa*, *Bromus purgans*, *Poa nemoralis*, *Campanula rotundifolia*, *Aquilegia canadensis*, *Hydrophyllum virginicum*, *Taxus canadensis*, *Sambucus racemosa*, *Phegopteris calcarea*, *Acer spicatum*, *Aconitum uncinatum*, *Viola blanda*, *Saxifraga pennsylvanica* and *Arabis lyrata* were distributed throughout the region. The *Poa nemoralis*, *Arabis lyrata* and *Campanula americana* occurred upon the limestone rocks with little soil. They occurred with numerous species of lichens, of which the following are prominent: *Buellia albo-atra*, *Lecanora privigna*, *L. calcarea* var. *contorta*, and *L. muralis* var. *versicolor*. The *Polypodium vulgare*, *Circæa alpina* and *Cypripedium pubescens* were more or less local. Most of the limestone rock has become covered with vegetation. It is only in the drier places that the *Arabis lyrata* thrives. The *Saxifraga pennsylvanica*, *Viola blanda* and *Bromus kalmii* occur in the moister places.

Flora of the Wisconsin Drift.—There are three types of plant formations on the Wisconsin drift. First, the flora of the larger

1. Pinus strobus.

valleys of streams, second, the flora of the bogs and marshes, and third, of the prairies. The first has been considered in connection with the flora found along the Des Moines, the Iowa and other streams.

FIG. 24. In the interior of a group of White Birches, *Betula papyrifera* and *Corylus rostrata*, *Pyrus arbutifolia*, covering the ground in the foreground. Photograph by L. H. Pammel.

In Hamilton, Story and Wright counties, ancient lake beds are numerous, but nowhere do they present as many typical boreal plants as in Cerro Gordo, Hancock and Worth counties. In Hamilton county the old Mud Lake was a shallow body of

water covering about fourteen hundred acres. The depth of the water was only a few feet in most places, varying with the amount of rainfall. The marginal flora of the lake consisted largely of *Scirpus lacustris*, *Typha latifolia*, *Zizania aquatica*, and *Nymphæa tuberosa*. On the margin, in marshy ground, *Iris versicolor*, *Scirpus atrovirens*, *Eleocharis palustris* formed the most characteristic plants before its drainage.

Generally speaking, the flora of the Wisconsin drift contains the characteristic prairie vegetation not unlike that of other western prairie states. The several species of *Liatris*, its broad

FIG. 25. *Nelumbo*, Mississippi River, near Redwing, Wisconsin side. Photograph by J. E. Guthrie.

waving fields of *Andropogon* accompanied by *Phlox pilosa*, *Panicum scribnerianum*, *P. virgatum*, *Vicia americana*, *Geranium maculatum*, *Rosa blanda* var. *arkansana*, *Ceanothus americanus*, *Echinacea purpurea*, *Lithospermum canescens*, *L. angustifolius*, *Viola palmata* var. *cucullata*, *V. pedata*, *Castilleia sessilifolia*, *Astragalus caryocarpus*, *Stipa spartea*, *Ceanothus ovatus*, and *Delphinium azureum*.

The Flora of the Bogs of Cerro Gordo and Worth Counties—These bogs are interesting from a phytogeographical standpoint. We have here representatives of a flora common in Minnesota to the north and the bogs of western Wisconsin. Many species have, however, disappeared in their immigration southward and northward. The conditions favorable for the development of these glacial plants have gradually disappeared, owing to the absence of proper soil and temperature conditions. The long and hot summers greatly increased the heat of the soil and water in which these plants thrive, hence their extermination. A few illustrations will suffice. The *Cnicus muticus*, though common in these bogs, occurs more commonly in Wisconsin marshes that are fairly dry during the latter part of the season. The same may be said of *Parnassia caroliniana*, *Chelone glabra*, *Thalictrum purpurascens* and *Pedicularis lanceolata*. The *Salix candida*, *Lobelia kalmii* and *Circuta bulbifera* are equally common in the bogs of western Wisconsin and in Worth county. The *Salix richardsonii* and *S. discolor* are found throughout the Wisconsin drift area. The *Hierochloe borealis* hardly reaches the southern end of the Wisconsin drift as it only reaches as far south as Marshall and Hamilton counties. This grass, however, can hardly be classed as a real bog species as it is usually found on moist drift soils further northward. A hasty survey certainly shows that the Wisconsin drift has influenced in a marked manner the flora of northern central Iowa.

A brief list of the plants shows that the sphagnum which constitutes the bulk of the vegetation in the bogs of Wisconsin is entirely lacking in Worth and Cerro Gordo counties, and in place we find *Hypnums*. The bogs, however, contain a number of most interesting northern plants, among them *Bidens beckii*, *Cnicus muticus*, *Gentiana crinita*, *G. quinqueflora*, *G. andrewsii*, *Parnassia caroliniana*, *Cicuta bulbifera*, *Bromus kalmii*, *Thalictrum purpurascens*, *Salix discolor*, *S. richardsonii*, *S. candida*. The *Salix richardsonii* and *Populus tremuloides* are quite conspicuous shrubs. Owing to the deposit of soil through cultivation these bogs are beginning to "dry up," as the common expression is. Scattered throughout the bogs are small groups of *Populus tremuloides* which in course of time will give rise to a mesophytic forest. In fact, the course of the formation of the forest here is very

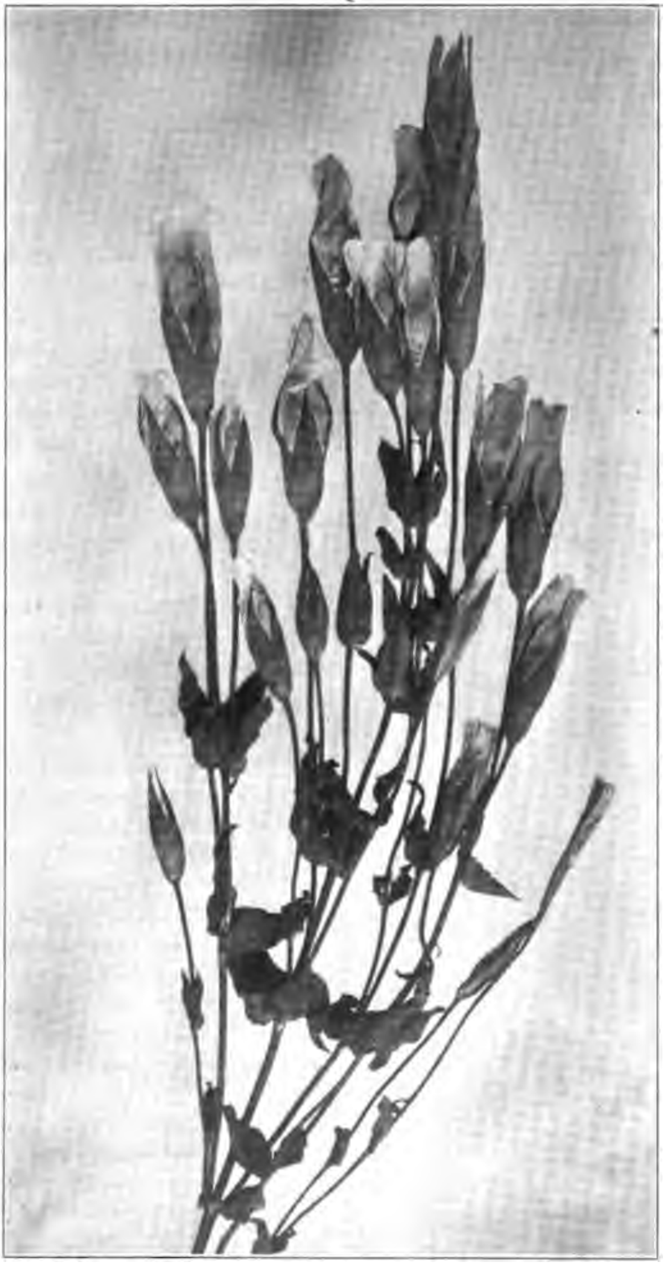


FIG. 26. *Gentiana crinita* in marshes and bogs of the Wisconsin drift. Photo. C. M. King

different than in northern Michigan, Wisconsin or Minnesota. The reason for this is no doubt the lack of forest-forming species in the immediate vicinity, the tamarack and spruce both being absent and no seed any where in the vicinity.

STEAMBOAT ROCK.

The Flora of the Flood Plains of the Iowa River.—This formation has in a large part lost its original aspect. The more important trees found here consist of the Soft Maple (*Acer saccharinum*), the Box Elder (*Negundo aceroides*), the Corky Bark Elm (*Ulmus racemosa*), *U. americana*, *Fraxinus viridis* and *Populus monilifera*. The shore line of the stream has an abundance of *Eragrostis reptans*, *Cyperus erythrorhizos*, *C. diandrus*, *Hemicarpha subsquarrosa*, *Lobelia cardinalis*, *L. syphilitica*, *Leersia virginica*, and *L. oryzoides*.

The second shore line consists of a black sandy humus. But a small proportion of the original forest remains The chief type of trees found here consists of the Hard Maple (*Acer nigrum*), *Juglans nigra*, *J. cinerea*, *Ulmus fulva*, some *U. americana*, and *U. racemosa*, *Carya amara*, *Quercus macrocarpa*, and *Q. rubra*, *Cratægus mollis* and *C. punctata*, *Pyrus iowensis*, *Prunus amer.*

FIG. 27. *Bromus ciliatus* var. *latiglumis*. Common in marshes. Photograph by Charlotte M. King.

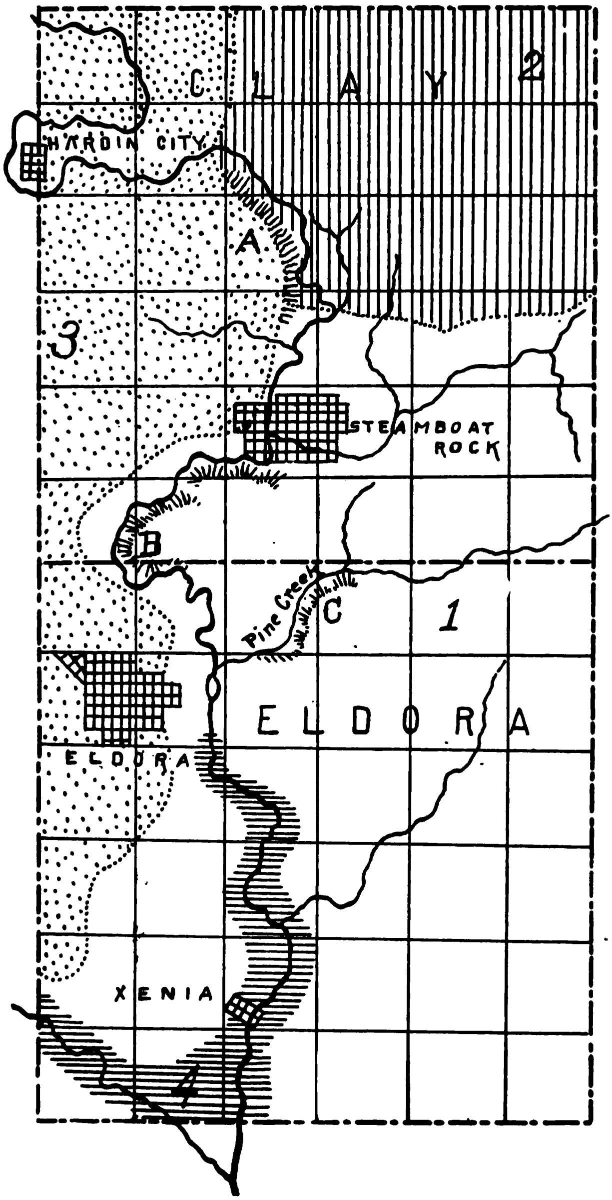


FIG. 28. Map of the Steamboat Rock region. The White Pine along Pine Creek and the Sandy Ledges between Pine Creek and Steamboat Rock. The Cherry Birch at B. 1=Kansan Drift. 2=Iowan Drift. 3=Wisconsin Drift. After S. W. Beyer.

Rocky Talus and Sandstone Ledges.—The rocky talus and sandstone ledges contain an interesting assemblage of boreal plants. The soil is black sandy loam with a rich humus. The narrow strip between the river and the vertical cliffs is shaded and contains a dense mass of plants consisting of several species that are quite rare in the state of Iowa.

FIG. 29. *Pinus strobus, Betula papyrifera, Cornus circinata, Osmunda claytoniana, Smilacina trifolia* on Pine Creek, Hardin county. Photograph by Charlotte M. King.

Of the trees, the following are the more important: *Pinus strobus, Betula papyrifera, B. lenta*, and associated with these trees are the following shrubs: *Cornus circinata, Dierville trifida*, and

Lonicera sullivantii. Of the more common Iowa trees we may mention *Juglans cinerea*, *Quercus rubra*, occasional; *Acer nigrum*, *Juniperus virginiana*, *Cratægus margaretha* and *Amelanchier canadensis*. Of the herbaceous plants the *Aspidium marginale* is abundant for some distance underneath the shaded woods, along with it also the *Aspidium spinulosum* var. *intermedium*, *Polypodium vulgare* and *Phegopteris dryopteris*. The *Lycopodium lucidulum* is rare.

FIG. 30. *Danthonia spicata*, on the dry sandstone rocks. (U. S. Dept. Agrl.)

Along Pine Creek, where similar outcrops of sandstone occur but of less height, the White Pine is more abundant, there being trees here that are two to three feet in diameter and 70 or 80 feet high. Along the shaded places the *Osmunda claytoniana*, *Cornus circinata*, *Diervilla trifida*, and *Cypripedium spectabile* are abundant. Further up the Iowa river along the shaded bluffs where the Iowan drift occurs on steep banks the *Juniperus communis* is abundant. During the spring these banks are very moist. The *Cypripedium spectabile* is not infrequent, and *Salix discolor* and *Dirca palustris* are abundant. This region is always moist. The soil is a deep yellow loam overlaid by a black humus.

Of the many plants occurring upon the dry ledges, attention may be called to *Campanula rotundifolia*, *Danthonia spicata*, *Eragrostis capillaris*, *Lechea major*, *Heliathemum canadense*, *Erig-*

eron divaricatus and *Draba caroliniana*. In the shaded woods, during the early spring, under the sandstone ledges and elsewhere in the region, the *Trillium nivale*, *Viola pubescens*, *Isopyrum biternatum*, *Dicentra cucullaria* and *Anemone nemorosa* are abundant.

PERCENTAGE OF TREES.

The percentage of trees found on different formations near Steamboat Rock is here given. The forests of Hardin and Marshall counties during the early days were important in the building of railroads as well as for fuel. It may be of interest, therefore, to give a table showing the percentage of trees on the different formations found in the vicinity of Steamboat Rock.

FORMATION.	SPECIES.	PERCENTAGE.
Sunny, sandy slope	*Quercus alba*	3.3
" " "	" *rubra*	3.6
" " "	" *tinctoria*	12.1
" " "	" *macrocarpa*	12.1
" " "	*Ostrya virginica*	27.3
" " "	*Carya alba*	12.1
" " "	*Juglans cinerea*	9.9
" " "	*Tilia americana*	9.9
" " "	*Prunus serotina*	9 6
Rocky, sandv talus	*Quercus alba*	3.8
" " "	" *macrocarpa*	19.6
" " "	" *tinctoria*	26.2
" " "	*Prunus americana*	6.0
" " "	" *serotina*	4.6
" " "	*Pruuus virginiana*	26.1
" " "	*Populus tremuloides*	7.9
" " "	*Cratægus mollis*	4.6
" " "	*Pyrus coronaria*	1.2
Sandy loam, north slope	*Prunus serotina*	12.1
" " " "	*Juglans cinerea*	6.2
" " " "	*Ostrya virginica*	20.0
" " " "	*Acer nigrum*	12.0
" " " "	*Carya alba*	20.0
" " " "	*Betula alba*	1.9
" " " "	*Cratægus margaretha*	5.5
" " " "	" *punctata*	2.2
" " " "	*Quercus alba*	8.1
" " " "	" *rubra*	10.0
" " " "	" *tinctoria*	2.0
Black loam, top of hills	*Carya alba*	12.1
" " " " "	" *porcina*	3.0
" " " " "	*Quercus tinctoria*	20.1
" " " " "	*Fraxinus americana*	2.5

Black loam, top of hills	*Fraxinus viridis*	1.5
" " " " "	*Tilia americana*	18.1
" " " " "	*Quercus rubra*	10.1
" " " " "	" *alba*	10.0
" " " " "	*Ulmus fulva*	20.1
" " " " "	*Cratægus mollis*	2.5

The undergrowth in this forest consisted of *Rubus strigosus, Solidago ulmifolia, Silphium perfoliatum, Aster sagittifolius, Celastrus scandens, Helianthus strumosus, Ribes gracile, Cornus sericea, Corylus americana, Agrimonia eupatoria, Solidago canadensis, Prunus pennsylvanica.*

FORMATION.	SPECIES.	PERCENTAGE.
Carboniferous Sandstone, shady west slope, from rocky ledge to river	*Acer nigrum*	8.2
"	*Acer saccharinum*	3.0
"	*Fraxinus viridis*	4.5
"	" *sambucifolia*	2.0
"	" *americana*	2.0
"	*Betula papyrifera*	4.2
"	" *lenta*	24.1
"	*Amelanchier canadensis*	10.4
"	*Juniperus virginiana*	1.0
"	*Ulmus fulva*	3.0
"	" *americana*	3.0
"	*Pinus strobus*	2.17
"	*Quercus alba*	6.5
"	" *tinctoria*	4.8
"	" *rubra*	6.4
"	*Carpinus caroliniana*	4.4
"	*Ostrya virginica*	10.4

The undergrowth consisted largely of *Corylus americana, Diervilla trifida, Aspidium marginale, Phegopteris dryopteris, Cornus alternifolia* and *C. circinata.*

FORMATION.	SPECIES.	PERCENTAGE.
Sandy alluvial flood plains	*Populus monilifera*	3.1
" " " "	*Quercus macrocarpa*	5.2
" " " "	*Prunus serotina*	2.9
" " " "	*Quercus rubra*	2.9
" " " "	*Juglans cinerea*	17.4
" " " "	" *nigra*	15.3
" " " "	*Negundo aceroides*	3.1
" " " "	*Ulmus americana*	10.1
" " " "	" *fulva*	2.4
" " " "	*Fraximus viridis*	8.1
" " " "	*Acer saccharinum*	6.1
" " " "	" *nigrum*	15.6
" " " "	*Pyrus iowensis*	2.9
" " " "	*Prunus americana*	3.1
" " " "	*Cratægus mollis*	2.5
" " " "	" *punctata*	2.0

These figures indicate that this sandy alluvial bottom contains species of plants that are common to other places in the region. This is no doubt due, in part, to the fact that the water does not long stand on the soil; then, too, the alluvial soil has a considerable mixture of sandy material, the soil being well drained.

FIG. 31. Part of a Bog in Worth and Cerro Gordo Counties. *Cnicus mutians, Salix Candida, Lobelia kalmii, Bromus kalmii* and *Populus tremuloides* to the right. Photograph by L. H. Pammel.

The bogs of Cerro Gordo and Worth counties may be compared with some very typical swamps in Wright and Hamilton counties. Both of these counties are in the Wisconsin drift area, and the swamps are in a more advanced stage than in the north

and east. These swamps have materially changed since the surrounding country has been brought into cultivation. That these swamps were once lakes, receiving the water from the surrounding country, admits of no doubt. The old beach line is plainly evident. In the larger of these lakes the outer beach was covered with trees and shrubs. Of this arboreal vegetation we may mention *Quercus macrocarpa*, *Ulmus fulva*, *U. americana*, *Fraxinus viridis* and *Tilia americana*.[1] There are few shrubs,—*Corylus americana*, *Rhus glabra*, *R. toxicodendron* and *Symphoricarpos occidentalis*. The smaller lakes are not surrounded by timber or shrubs. The outer beach line, which consists of a sandy gravel and humus, contains *Œnothera serrulata*, *Ceanothus americanus*,

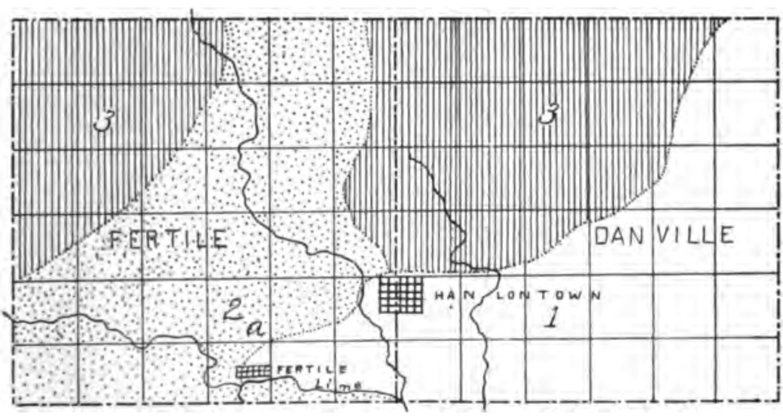


FIG. 32. Drift Sheets in Worth County. 1=Iowan, 2=Wisconsin, 3=Altamont Moraine.

Onosmodium carolinianum, *Verbena stricta*, *V. bracteosa*, *Lithospermum canescens*, *L. angustifolium*, *Castilleia sessiliflora*, *Solidago rigida*, *S. nemoralis*. *Poa pratensis* is abundantly naturalized. The second beach is thickly covered with *Scirpus atrovirens*, *Glyceria nervata*, *Thalictrum purpurascens*, *Juncus tenuis*, *Verbena hastata*, and *Hordeum jubatum*. Formerly *Cypripedium candidum* was common. The third beach is thickly covered with *Carex*, *Iris versicolor*, *Lathyrus palustris*, *Eleocharis palustris*, *Eupatorium perfoliatum*, *E. purpureum*, and *Asclepias incarnata*. The third beach is mostly made up of *Calamagrostis canadensis*, *Glyceria*

1. See L. H. Pammel, "Old Lake Vegetation of Hamilton County, Iowa." Plant World, 2: 43.

arundinacea, *Carex*, *Hypericum* and *Scutellaria galericulata*. This beach is followed by an abundant growth of *Phragmites communis*, *Scirpus lacustris*, *Typha latifolia*, *Menythayhes trifoliata* and *Zizania aquatica*. Formerly the center of the swamp was a lake in which *Nuphar advena* and *Nymphæa tuberosa* abounded, but owing to drying of the lakes these have in most instances disappeared. During the spring and early summer months there is an abundance of water in the small depressions containing diatoms, desmids and other fresh water algæ. This water is fairly rich in bacteria. Of the several plates poured, we found the following number of bacteria per cubic centimeter:

BACTERIOLOGICAL ANALYSES OF WATER.

	Agar.	Gelatin.	Colon Bacillus.
Story County. Pond.............	2000	2800	Present
	2400		
	2800		

	Agar.	Gelatin.	Litmus Lactose Agar.
Pond near Eagle Grove Iowa......	3640	60	2400
	3500		3000

Other ponds, rivers and spring waters in the state contained bacteria per c. c. as follows:

Spring Water.—The number of bacterial organisms found in spring water differs greatly. Mr. Buchanan has called attention to Spirogyra Cladophora and various diatoms found in spring water. It may be of interest here to add the number of organisms found in spring water from different parts of the state under different conditions. Open springs running through low marshes contain more bacterial organisms than the protected springs, or those that are cased in.

Algæ were relatively few in number in the limestone region of Allamakee county. Some of these springs contained large volumes of water,—sufficient to make a good-sized stream.

	Media.	Agar.	Gelatin.	Lit. Lac. Agar
Living Goose Spring, Allamakee County.		2400	1000	3700
		4800		
Smith Spring, Allamakee County.		2800		1800
				350

RIVER WATER SUPPLIES.

The number of organisms found in river water supplies varies greatly with the season. The following data may be of interest:

Fig. 33. Sandstone Region in Boone County, commonly called "The Ledges." Plants arranged. The *Cladonia* in dry open places. *Woodsia obtusa*, *Polypodium vulgare*, *Camptosorus rhizophyllus*. Moist sandy rocks. The *Adiantum pedatum* in moist woods, with *Cornus circinata* and *Viburnum pubescens*.

Skunk River. Number Bacteria per c. c. on Agar.

3200	5000	10320	3080	10030	19200
3240	2040	6200	1560		9080
11410	16590	12040			
10220		6650			

Iowa River.

Agar.	Lit. Lac. Agar
3500	300

Mississippi River.

Agar.	Lit. Lac. Agar.	Gelatin.
18906	5600	
8400		
8900		
18000	5600	709

Des Moines River.

Hour.	Temp.	Bacteria per c. c., No. 1.	Same, No. 2
10 a.m.	0°c.	40	
11 a.m.	0°c.	1000	2750
12 m.	0°c.	500	1800
1 p.m.	1°c.	250	1000
2 p.m.	1°c.	600	....
3 p.m.	1°c.	250	500

The Carboniferous Sandstone in Boone County.
The Ledges.

These rocks have been formed under conditions similar to those of Hardin county. The flora is similar in some respects, but several important species have dropped out. There are no springs at present anywhere along Pease Creek, except in the prairie, though at the base of the rocks at Katina Falls a few small springs of good water occur. Pease Creek carries water during the entire year. This water comes largely from the meadows above the timber belt. The following plant formations occur in this region:

1. Sandstone formation, consisting of the
   a. Exposed dry rock.
   b. Moist talus and ledges.
2. The sandy, loamy, treeless slope. This again may be (a) dry or (b) moist.
3. The tree-covered slopes divided again into (a) moist exposures and (b) dry exposures.
4. Sandy bottoms along Pease Creek, (a) Mesophytic; (b) Hydrophytic.
5. Des Moines alluvium, (a) Forest, (b) Swamps.
6. Marshes above the coal measure shales.

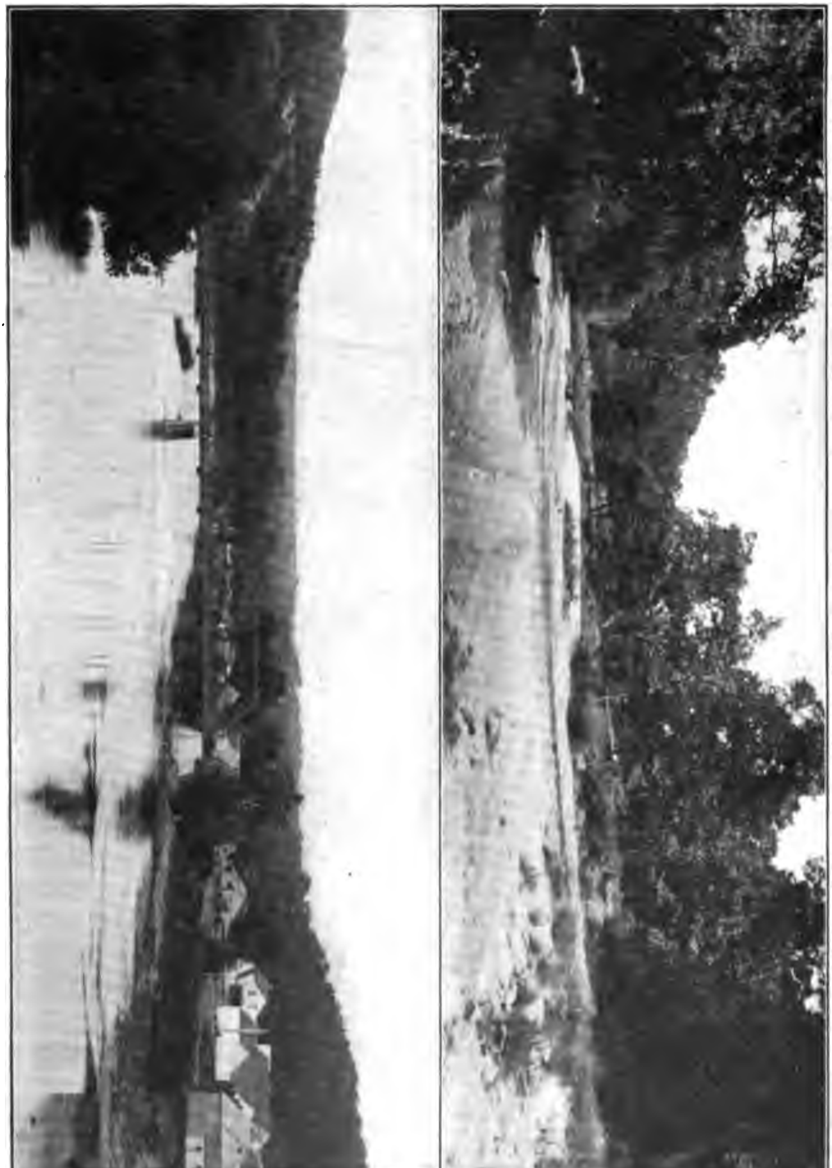


FIG. 34. The topography of the region about the ledges, Boone county, Iowa. Lower picture shows Moingona Bridge (Kate Shelley Bridge); the upper, alluvial region of the Des Moines near the ledges. *Acer saccharinum, Ulmus americana, Leersia virginica.*

1. *Sandstone Ledges.*—The Sandstone exposed dry rock contains some lichens, *Eatonia obtusata*, *Capsella bursa-pastoris*, *Taraxacum officinale*, *Erigeron canadensis*, *Chenopodium hybridum* and *Pilea pumila*. Many of the plants occurring here are annuals and make their growth in the spring. The moist rocks and talus contain *Aralia racemosa*, *Aralia nudicaulis*, *Camptosorus rhizophyllus*, *Cornus circinata*, *C. alternifolia*, *Galium aparine*, *G. boreale*, *Phryma leptostachya*, *Rudbeckia hirta*, *Woodsia obtusa*, *Cystopteris fragilis*, *Conocephalus*, sp., *Fragaria vesca*, *Polypodium vulgare*, *Mitella diphylla*, *Actaea spicata* var. *rubra*, *Prenanthes alba*, *Amphicarpæa monoica*, *Thalictrum dioicum* and *Teucrium canadense*.

Where sufficient age has been attained the rocks are covered with a mantle of clay and humus now overgrown with a good growth of young oak, (*Quercus rubra*), *Cornus circinata*, *Cornus alternifolia*, *Viburnum pubescens*, *Populus grandidentata*, *Acer nigrum*, *Juniperus virginiana*, *Rhamnus lanceolata*, *Quercus alba*, *Q. muhlenbergii* and *Amelanchier canadensis*. Of the herbaceous plants, *Thalictrum dioicum*, *Lathyrus venosus*, *L. ochroleucus*, *Cypripedium pubescens*. *Asarum canadense*, *Trillium nivale*, *Aralia nudicaulis*, *A. racemosa*, *Monarda fistulosa*, *Agrimonia eupatoria*, *Eupatorium ageratoides*.

The open spaces are covered with *Cladonia sylvatica*, *Polytrichum juniperium*, *Helianthemum canadense*, *Lechea major*, *Danthonia spicata*, *Eatonia obtusata*, *Koeleria cristata*, *Euphorbia corollata*, *Petalostemon candidus* and *P. violaceus*.

The ferns are particularly noteworthy here. The walking leaf fern is found only in a few scattered places either upon the talus or upon the damp vertical cliffs. It is associated particularly with *Polypodium vulgare*, *Woodsia obtusata*, several species of moss, occasionally with *Mitella diphylla*, *Thalictrum dioicum* and lichens.

2. The sandy, loamy, treeless area occupies but limited portions of the region. In the more dry and exposed places the reindeer lichens, *Cladonia sylvatica*, and a variety occur, as well as *Agrostis scabra*, *Danthonia spicata*, *Polygala senega*, *Comandra umbellata*, *Polygala verticillata* and *P. sanguinea*, with a few Leguminosæ like *Amorpha canescens*, *Petalostemon violaceus*, *P. candidus*, and the Evening Primrose (*Œnothera biennis*), which is

more or less weedy, and such composites as *Taraxacum officinale*, *Aster multiflorus*, *Solidago rigida* and *S. nemoralis*, also *Lechea major* and *Helianthemum canadense* are the more important plants of the drier situations. In the more moist situations *Cladonia sylvatica* grows to greater perfection, frequently surrounded with an abundant growth of *Polytrichum commune* and another moss, *Funaria flavicans*. Among the earlier spring flowering plants we note the *Anemone nemorosa*, *Polygala senega*, *Aralia nudicaulis* and *Antennaria plantaginifolia*, forming large masses. Among the later plants *Hieracium canadense*, *Aster lævis* and *A. azureus* are found.

3. *Tree-covered Slope.*—The greater part of the tree-covered slope consists of trees common in central Iowa. At one time it was thickly covered with timber. However, the beginning of a young forest has speedlly taken the place of the old.

(a). Some of the plants found here are *Arabis lævigata*, *Aralia racemosa*, *Botrychium virginianum*, *Cornus alternifolia*, *Cornus circinata*, *Cystopteris fragilis*, *Desmodium nudiflorum*, *Galium aparine*, *G. boreale*, *Heliopsis scabra*, *Phryma leptostachya*, *Silene stellata*, *S. nivea*, *Viola palmata*, *V. cucullata*, *V. pubescens*, *Adiantum pedatum*, *Carpinus caroliniana*, *Ostrya virginica*, *Monarda fistulosa*, *Populus grandidentata*, *Lathyrus ochroleucus*, a very rare plant in central Iowa, *Quercus alba*, *Q. rubra*, *Carya amara*, *C. alba*, *Juniperus virginiana*, which more properly belongs to the dry talus, but there are scattered trees and shrubs throughout the woods, like *Rhamnus cathartica*, *Viburnum pubescens*, *Corylus americana*, and *Prunus pennsylvanica*.

(b). *Quercus muhlenbergii*, *Rhus glabra*, *Cornus candidissima*, *Bromus purgans*, *Arabis lævigata*, and a host of plants that are common to both regions, as the following: *Amelanchier canadensis*, *Cornus paniculata*, *Desmodium nudiflorium*, *Hydrophyllum appendiculatum*, *Populus grandidentata*, *Acer nigrum*, *Solidago ulmifolia* and *Asprella hystrix*.

4. *Sandy Bottoms.*—The fourth division contains many plants common to the upland, such as *Impatiens pallida*, *Astragalus canadensis*, *Œnothera biennis*, *Fraxinus pubescens*, *Agrostis perennans*, *A. alba*, *Poa pratensis*, *Laportea canadensis*, *Carex straminea*, *C. pennsylvanica*, *Panicum lanuginosum*, *Melilotus alba*, *Lithospermum latifolium*, *Cicuta maculata*, *Ulmus racemosa*, *Acer nigrum*, *Strophostyles angulosa* and *Lippia lanceolata*.

Of the hydrophytic plants few remain. *Spirogyra*, *Zygnema*, *Cardamine rhomboidea*, *C. hirsuta* and *Caltha palustris* are the more important plants occurring in the brook. The water in Pease Creek flows rather rapidly, so that few plants of this type obtain a foothold. They are, however, found attached to sticks or occur on the shores.

5. *Des Moines Alluvium.*—The character of the vegetation of the alluvial bottom of the Des Moines River is not essentially different from that in other sections in central Iowa. We have

FIG. 35. Marshes of the prairie region of central Iowa. *Scripus lacustris*, *Sagittaria*, *Ranunculus multifidus* and *Iris versicolor*. Story county, Iowa. Photo. by C. M. King.

the soft maple (*Acer saccharinum*), *Negundo aceroides*, *Ulmus americana*, *Fraxinus viridis*, *Populus monolifera*, *Salix amygdaloides*, *S. longifolia* and *S. nigra* as the most important of the trees and shrubs. Under the shade of these trees or on the margin of the woods we find the following herbaceous plants: *Leersia virginica*, *Elymus virginicus*, *Panicum crus-galli*, *Pilea pumila*, *Bidens frondosa*, *Vernonia fasciculata*, *Aster tradescanti*, *Nasturtium palustre*, *Cinna arundinacea*, and *Spartina cynosuroides*. It

is remarkable that the Sycamore, *Platanus occidentalis*, does not occur along the banks of the Des Moines in the vicinity of the Ledges (at least the writer has never seen it) while it is abundant at Ames, on the Skunk River, and Squaw Creek and also at Des Moines along the Des Moines and lower Coon. Dr. Beyer has shown that the Des Moines River during the post-glacial times had its course further eastward, flowing into what is now Skunk River just north of Ames. It is equally remarkable that the Buckeye, *Æsculus glabra*, does not occur on the Skunk River just north of Ames, nor for that matter in the country along the Skunk River, though common further southward. On the other hand *Æsculus glabra* is not infrequent along the Des Moines as far north as Frazer in Boone county. However, this species is found on the hills. What causes have operated to bring about this somewhat anomalous distribution can not be answered until a more extended investigation can be made of the causes that underlie the northward and southward extension of species.

(b) The swamps are adjacent to the Des Moines River. These swamps are not conspicuous in the vicinity of the Ledges as the banks rise rather abruptly. But where they are developed they appear at one time to have been bayous of the river. During times of high water they were filled and contained a large number of aquatic plants. These bayous have gradually been filled by the accumulation of sedimentary material so that near the mouth of small streams they have become flattened areas. During the spring of the year they are quite moist, since the drainage is not perfect. In the little depressions that are formed we find the more conspicuous plants to be *Iris versicolor*, *Typha latifolia*, *Lobelia syphilitica*, *Carex trichocarpa* var. *aristata*, and further on the drier uplands of the banks, *Carex stricta* and *Salix discolor*. Where drainage has been more perfect and the accumulation of a greater amount of sedimentary material has occurred, a high second bottom is frequently formed. These are not marshes in any sense of the word, but have been developed from the marshes just mentioned. In these alluvial upland bottoms the *Acer nigrum*, *Ulmus fulva*, *Celtis occidentalis*, with *Phlox divaricata* and *Asarum canadensis* form the more conspicuous plants.

6. The marshes above the coal measures, shales, carry moisture during the entire year. Here we find perennial springs.

Where there is much moisture they are treeless. A single typical area in the vicinity of High Bridge may be taken as a type. This area covers about two acres in extent and is typical of the numerous other small marshes found in the vicinity, and typical also for other marshes in central Iowa. The only shrubs occurring in the vicinity of the springs are the *Salix discolor* and *S.*

FIG. 36. Shooting Star (*Dodecatheon media*). On open prairie near Jewell Junction, Iowa.

rostrata. The banks surrounding the spring are covered with *Cardamine rhomboidea*, *Caltha palustris*, followed by *Cardamine hirsuta*, *Viola cucullata*, *Glyceria nervata*, *Lathyrus venosus*, *Thalictrum purpurascens*, *Calamagrostic canadensis*, *Eupatorium purpu-*

reum, *E. perfoliatum*, *Chelone glabra*, *Aster umbellatus*, *Gentiana crinita*, *Cypripedium candidum*, *Aster salicifolius*, *Solidago serotina* and *S. ohioensis*.

7. *The Prairie Vegetation.*—The plants of this area are similar to the plants found in many other sections in central Iowa, especially that affected by the Wisconsin drift. The morainic flora consists of plants that are usually adapted to drier conditions. The *Anemone patens* var. *nuttalliana*, *A. caroliniana*, and *Draba caroliniana*, are rare plants. The more common plants of

FIG. 37. A bit of prairie with *Dodecatheon media*, near Jewell Junction, Iowa.

this drift material are *Viola pedata* and *V. pedatifida*, *Castilleia sessiliflora*, *Lithospermum angustifolium*, *L. canescens*, *Polytænia nuttallii*, *Ceanothus ovatus*, *Œnothera serrulata*, *Stipa spartea*, *Baptisia leucophæa* and *Rudbeckia hirta*.

The flora of the lower and flat areas consists of *Anemone pennsylvanica*, *Thalictrum purpurascens*, *Juncus tenuis*, *Panicum scribnerianum*, *P. virgatum*, *Liatris scariosa*, *L. pycnostachya*, *Vicia americana*, *Baptisia leucantha*, *Lilium philadelphicum*, *L. canadense*, *Spiranthes cernua*, *Lathyrus venosus* and *Cicuta maculata*.

In these ponds, which may become dry, the floating *Utricularia vulgaris* is common; *Carex trichocarpa* var. *aristata*, *C. crus-corvi*, *Scirpus atrovirens*, *Ranunculus multifidus*, *Iris versicolor* and *Phalaris arundinacea* occur; *Phragmites communis* and *Scirpus lacustris* are common.

Fig. 38. *Sagittaria variabilis* and *Scirpus lacustris*. Many algæ are found in such ponds in the spring. These ponds may become partially dry towards the close of the season. Photograph by Charlotte M. King.

The Cordova Sandstone Ledges.—The Cordova sandstone ledges are somewhat similar to those of Boone and Hardin counties. They occur in Marion county, some distance southeast from Des Moines, along the Des Moines River. The boreal plant types

have largely disappeared. The ferns consist chiefly of *Cystopteris fragilis* and *Adiantum pedatum*.

The trees found here are those common to central Iowa with the exception of the common occurrence of the Buckeye (*Æsculus glabra*) and *Cercis canadensis*, which occur at the base of the bluffs. The Redbud, while not present in the immediate vicinity of the ledges, does occur near Des Moines. The *Delphinium tricorne* grows in the rich soil at the base of the bluffs among the broken fragments of the sandstone rock. We note upon the tops of the bluffs two southern representatives, the *Poa trivialis* and

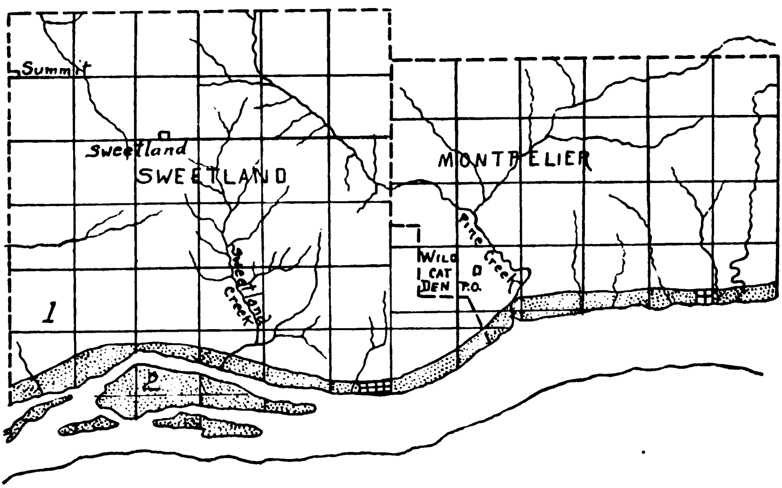


FIG. 39. Map of the Pine Creek region, Muscatine county, Iowa. 1=Iowan loess; 2=Alluvium. The White Pine, *Gaylussacia*, *Phegopteris hexagonoptera* and *Aspidium lonchitis*, found in the Pine Creek region. After Iowa Geological Survey.

Myosotis verna. *Cerastium nutans* and *Cynthia virginica* are also common, though absent in Hardin and Boone counties. The *Poa trivialis* is generally considered native of northern Europe but it is undoubtedly indigenous to this country. If we compare these regions with the Pine Creek region of Muscatine county, farther southeast on the Mississippi, we find the following very interesting facts.

Pine Creek Region of Muscatine County.—The Pine Creek region of Muscatine County contains among other plants the following: *Circæa alpina*, *Aspidium acrostichoides*, *Gaylussacia resinosa*, *Panicum glabrum*, *Aspidium cristatum*, *Camptosorus rhizophyllus*, *Asplenium thelypteroides*, *Adiantum pedatum*, *Pteris aquilina*, *Polypo-*

dium vulgare, *Lycopodium lucidulum*, *Osmunda claytoniana*, *O. cinnamomea* and *O. regalis*.

The White Pine in Muscatine county is the most southern extension of the species in the state of Iowa. On the slope of the hills other trees common to the state, like *Juglans cinerea*, *Quercus alba* and *Q. rubra*, occur.

Lespedeza violacea and *L. reticulata* occur in drier soil. *Cercis canadensis*, *Cerastium nutans*, *Arenaria latifolia*, *Goodyera pubescens*, *Fragaria vesca*, *Convolvulus spithamaeus*, *Agrimonia parviflora*, *Spirea aruncus*, *Rubus cuneifolius*, *Aster cordifolius*, *A. corymbosus*, *A. macrophyllus*, *Chelone glabra*, *Gerardia tenuifolia* var. *asperula*, *Maianthemum canadense*, *Camassia fraseri* are other species of the region.

Of the rarer plants occurring in this vicinity, but not on these sandstone bluffs, mention may be made of *Rhexia virginica*, *Phlox bifida* along the Cedar River; *Symplocarpus foetidus*, *Allium tricoccum*, *Calopogon pulchellus* in boggy places in the Cedar River region; *Dodecatheon meadia* is rather common on prairies; *Angelica atropurpurea* in low lands. *Cicuta bulbifera*, *Pentstemon grandiflorus*, *Breweria pickeringii*, *Cristatella jamesii*, *Helianthus petiolaris* and *Panicium autumnale* is more or less common on Muscatine Island.

Mr. R. E. Buchanan has contributed the following on the Algal Flora of the region. The algæ were listed by Dr. Bessey.[1]

Notes on the Algal Flora of the Region.

BY R. E. BUCHANAN.

No collections were made of the algæ from southwestern Wisconsin, but the following method furnished us with the names of a few of the algæ that are abundant in that locality. Three types of the soil of that locality were placed in separate sterile jars and covered with water. Each of the jars soon developed an abundant growth of the algæ.

The peat soil naturally was by far the most productive of forms. The relative abundance of the organisms as they occur in the peat naturally and in the aquarium was certainly different,

1. Bull. Ia. Agr. Coll., Bot. Dept., 1884: 139.

but all those that were found are fitted just as certainly for life in the peat bogs of that country. The list of forms is as follows:

Oscillaria tenuis.
Oscillaria natans.
Anabæna flos aquæ.
Scenedesmus dimorphus.
Scenedesmus obtusus.
Tetraspora lubrica.
Protococcus viridis.
Ulothrix zonata.
Chætophora elegans.
Gonium pectorale.
Gomphonema constrictum.
Cymbella cuspidata.
Synedra sp.

The other two soils examined in this manner were a yellow clay and a yellow loam. The same organisms developed in both of these jars. Neither of these soils was, of course, naturally under water. The algæ therefore are of a character to take advantage of any increase in moisture, to make a rapid growth, and to resist dessication. The list of organisms is as follows:

FIG. 40. *Leersia lenticularia* in low grounds along the Mississippi. (U. S. Dept. Agrl.)

Oscillaria violacea.—Forms a dense mat over the surface of the clay. Bubbles form underneath and it is forced up until it floats.
Nostoc muscorum.
Oscillaria tenerrima.
Stauroneis sp. Very minute.

The only collection of algæ from northeastern Iowa that was examined was one that came from the effluent of one of the large springs that issue from the limestone rocks of that region. It con-

sisted of a dense mat of *Vaucheria sessilis* in fine fruit. The collections that have been made in the vicinity of the Ledges in central Iowa have been more numerous. Here are to be found a number of springs, ledges of limestone and sandstone rock, creeks and the Des Moines River. The algal flora is therefore very varied and mention can be made of a few only of the many forms.

The water that issues from the springs of this region supports a very characteristic flora. The shallow, cold, clear water seems to be a favorite locality for the *Vaucheria*. These are of the two species, the *V. sessilis* and the *V. geminata racemosa*. These mats, sometimes several feet in diameter and an inch thick, are the home of a large number of diatoms. Wherever the water trickles in fine streams along the surface of the rocks will be found the *Nostoc muscorum* and the *Scytonema*. These, with the *Pleurococcus*, form the gonidia of the hundred or more lichens that are to be found in this locality. In one little pool exposed to the full rays of the sun and quite warm, the *Rhaphidium polymorphum* was so abundant that the whole mass of the water was of a dark green.

FIG. 41. *Poa chapmaniana* in fields and flood plains of southeastern Iowa. (U. S. Dept. Agrl.)

The rocky streams that cut through these ledges of rock have as their most conspicuous alga the *Tetraspora cylindrica*. At times during the summer the stones in the bed are covered with long streamers of this alga. These sometimes reach to a length of several feet. Diatoms of many species are here to be

found also. In the quiet pools may be found masses of the *Spirogyras*, such as *S. crassa* and *S. fluviatilis*, together with *Closteriumlanceolatum* and *Zygnema stellium*.

The Des Moines River at this point is deep and muddy, offering a very poor chance for any considerable growth of the algæ. In some of the quieter bayous and the shallows, however, a few forms may be found. Among these are the following:

Merismopedia glauca.	*Spirogya deciminata.*
Nostoc commune.	" *maiuscula.*
Anabæna flos-aquæ.	" *varians.*
Cylindrospermum macrospermum.	" *dubia.*
Oscillaria tenuis.	*Vaucheria sessilis.*
Oscillaria viridis.	*Microspora abbreviata.*
Tetraspora lubrica.	*Ulothrix subtilis.*
Characium naegeli.	*Stigeoclinum tenua.*
Tetrædon longispinum.	*Cladophora fracta.*
Closterium acerosum.	*Euglena viridis.*
Zygnema stellium.	*Œdogonium capillare.*

The above is not the result of any single collection, but of several collections at different times. Further collecting would probably considerably extend the list.

SOME LOCAL PROBLEMS IN THE GEOGRAPHICAL DISTRIBUTION OF THE WISCONSIN AND IOWA FLORA.

Several interesting problems on the geographical distribution of plants in the areas under consideration may now be discussed. Mr. C. C. Adams has shown that southeastern United States is a center of the geographical distribution of a part of our flora.[1]

Dr. John W. Harshberger, in his recent phytographic sketch of eastern and southeastern Pennsylvania, states as follows: "With the retreat of the great ice-sheet, the region once covered by the ice was restocked by trees and herbs derived from three main sources of supply: (1) Scandinavia, (2) Hudsonian zone of the Glacial period, (3) Appalachian forests (north and south). The Scandinavian plants migrated eastward during the interglacial peroid and tenanted the moraines, nunataks and arctic strip of territory throughout the later glacial epoch. With the retreat

1. Biological Bull., 3: 123.

of the glaciers, they migrated northward with the ice sheet, or they persisted on the tops of high mountains which existed as nunataks during the ice age, or they remained as boreal islands in sphagnum bogs, or in cold and shaded ravines. A northward migration of Hudsonian species and of Appalachian species in concentric waves also took place at the close of the Glacial period.[1]

The action of the several uplifts and depressions of the earth's surface described was most profound upon this forest, the history of which has been traced. With every submergence of the lower portions of the creeks of the region and of the Delaware river, the forest in the area of submergence was destroyed, or if existing on the higher grounds, was subjected to such extensive changes of level as to modify its character and the distribution of the component species. Many species were crowded together by the change of level and the wearing away of the strata to which they had become adapted, for "if we suppose the earlier Mesozoic uplands to be the seat of the existing dicotyledons, then by the lowering of the surface by gradual consumption of the interstream areas, these forms must have been brought into conflict with the flora of the lowlands and thereby forced into a contest for supremacy."[2]

Dr. Livingston, in a discussion of the forests of Roscommon and Crawford counties, says: "The hardwood forest reappears quite rapidly when cut. This is doubtless in part due to the fact that this material does not burn so readily nor so violently as do the pines. The scattered white pines which formerly characterized some of these forests in the eyes of the lumberman are not returning. They are perhaps only a relic of a past generation of forest. Hemlock is reproducing well and will return with the beech and maple if, through lack of humus, the soil does not become too dry for the seedlings. Its seedlings stand close together and do not seem to suffer from one another's shade."[3]

It seems to me that the floras found at several different points, of the region here considered, especially the coinfers, are relics of a flora once abundant in this region.

1. Cf. Adams, C. C. Post-Glacial Origin and Migration of the Life of the Northeastern United States. Jour. Geol., 1903: 303.
2. Woodworth, J. B. The Relation Between Baseleveling and Organic Evolution. Am. Geol., 14: 231. 1894.
3. Bot. Gazette, 39: 38.

A few of our bog plants, *Pyrus arbutifolia*, *Nemopanthes fascicularis*, and *Rhynchospora alba* are southern and have migrated northward from the southern Appalachians, as suggested at least for the *Pyrus* by Transeau. The *Vaccinium corymbosum*, *V. atrococcum*, *Rhodora canadensis* and *Viburnum cassinoides* have not extended to our region. The *Gaylussacia resinosa*, though occurring in swamps, is not found in any of the bogs that I have studied, in either Wisconsin or Iowa. It does, however, occur in rocky woodlands of Muscatine county. It must be added to the immigrants from the southeast. One of the most striking immigrants from the southeast is *Rhexia virginica*, which occurs in the sandy swamps of the Cedar River near Muscatine. Nowhere in the region do the southern forms reach an optimum of development; they are crowded out by other dominant types; the same is true of the boreal types found here. The *Linnæa borealis*, *Vaccinium macrocarpon*, *Calopogon pulchellus*, *Pogonia ophioglossoides*, *Sarracenia purpurea*, *Drosera rotundifolia*, *Gentiana crinita* and *Campanula aparinoides* are some of the more important immigrants from the north.

These plants are, however, very local. Of wider distribution in swamps, the *Cnicus muticus*, *Menyanthes trifoliata*, *Valeriana edulis*, *Saxifraga pennsylvanica*, *Lobelia kalmii*, *Viola blanda* and *V. lanceolata*, reach over into Iowa. *Ledum latifolium* does not occur in our region, but near Kilbourne City, on the sandy rocks of the Dalles of the Wisconsin, it is found with *Thuya occidentalis*, *Pyrus americana* and *Aspidium fragrans*. The *Betula pumila* is quite common in the swamps of western Wisconsin, especially tamarack, but it scarcely reaches into Iowa. The *Salix candida* is common in similar places, and reaches over into Worth, Cerro Gordo and Winnebago counties, and south to Johnson county. There are, however, few stations south of Cerro Gordo county. The *Salix lucida* is common in tamarack swamps and extends down to Buchanan county, Iowa, two localities being given by Ball in his paper on "The Genus Salix in Iowa." The *S. rostrata*, though a tree, is generally of small stature in western Wisconsin and southeastern Minnesota. It is commonly found where the Wisconsin drift occurs and southeast to Johnson county, according to Ball. The *S. discolor* and the boreal willow are much more common in the swamps of northern

Iowa which occur from Dickinson, Boone, Monroe and Henry counties in the southeastern part of the state.

The *Taxus canadensis* is common in Wisconsin and extends south into Iowa as far as Linn county. The White Pine is most interesting in its distribution. It occurs in isolated areas as far south as Montpelier township in Muscatine county, the most southern point in Iowa. The groves in northeastern Iowa are larger and more frequent. In Hardin county there is one small area isolated from the areas in eastern Iowa. It is, however, more than probable that the species once had a much wider distribution.

There are well-preserved conifers in drift material from various parts of Iowa. Through the kindness of Mr. Savage I have been permitted to examine some wood in a fairly good state of preservation found in the southwestern part of the state. The wood appeared to be Red Cedar and Hemlock (*Tsuga canadensis*). Well-preserved wood has also been found in wells at a depth of 60 feet in northeastern Iowa. One piece was 14 inches long. According to Mr. Orr, these were probably conifers. They occur between the Iowan and Kansan drift. It is more than probable that coniferous forests once covered the entire state. Indeed Dr. Bessey thinks that in recent geological times coniferous forests were common in Nebraska.[1] The *Abies balsamea* is also a boreal species and occurs in an isolated area. The only point at which it occurs is in northeastern Iowa. It does not occur in western Wisconsin nor southeastern Minnesota. The *Larix americana* is more abundant, but is an exclusive swamp species. Of the four common trees found in swamps, the Black Spruce, Arbor Vitæ, Balsam and Tamarack, the latter is not uncommon in western Wisconsin. The balsam is found in northeastern Iowa, while the others are wanting in the area under consideration. The genus *Betula* is interesting from the standpoint of distribution. The *Betula papyrifera*[2] is common in western Wisconsin and northeastern Iowa. It is rare south of Dubuque on the Mississippi. Hardin county is the western limit in Iowa. *Betula lenta* occurs in western Wisconsin on sandy rocks, and in southeastern

1. Annual Report, Neb. St. Bd. of Agr., 1888: 93.
2. Betula alba.—Contr. Gray Herb., Harv. Uni., new ser., 23: 169. Amer. Jour. Sci., 14: 169: 1902.

Minnesota. It drops down into southeastern Minnesota, but is a rare tree. It is fairly common in one place in Hardin county, along the Iowa river at the base of sandstone ledges. The *Betula pumila* has been referred to as common in swamps in western Wisconsin.

It does not seem probable that the *B. lenta* was scattered by the northeast winds from northeastern Iowa, for at the time when the seeds are ripe the winds are usually west and southwest. The same may be said of the *Betula lenta*, which is not uncommon on the sandy rocks of the rivers of western Wisconsin in the latitude of La Crosse and in isolated places in western and southeastern Minnesota. The wind has played scarcely any part in its distribution in central Iowa. River Birch (*B. nigra*) no doubt owes its northern extension to its wind-dissemination. Its distribution may also have been aided somewhat by the water. Three conifers may briefly be mentioned as wind-disseminated. They are *Pinus strobus*, *P. resinosa* and *P. banksiana*.

P. banksiana is common only upon the pine barrens of the La Crosse River and northward and eastward. *P. resinosa* is found in a few outlying stations along the Black River, between Galesville and La Crosse, and is not uncommon on the east branch of the Kickapoo near Rockton. The White Pine and the *Larix americana*, as mentioned elsewhere, are more widely distributed.

The white pine in Hardin county was scarcely brought by the wind in recent times from northeastern Iowa. There are evidences of wind-dissemination of the larch and white pine for six or seven miles and the larch probably has been carried twelve miles. Generally speaking, the wind-disseminated plants are scarcely scattered as far and wide as those by birds.

Of the genus *Prunus*, the *P. pennsylvanica* is common in northeastern Iowa, Wisconsin and Minnesota. It is quite common in Hardin county, but rare in Story county, except in a few localities. In Boone county it is found on the sandstone ledges. The *P. serotina* is generally distributed in eastern Iowa, reaching out to central Iowa. The *Juglans nigra* is found everywhere on the larger streams like the Des Moines, Iowa, Cedar and Skunk rivers. The *Platanus occidentalis* is another southern species which has made its way northward along all the larger streams, nearly reaching the Minnesota line.

The *Carya sulcata*, so common southward, is found on Muscatine Island and in southeastern Iowa. The *C. tomentosa* is of somewhat wider distribution, but does not reach much further north than Muscatine. The Pecan is found as far north as Sabula.

The *Gymnocladus canadensis* reaches to the Minnesota valley. The *Morus rubra* is found in Houston county, Minnesota. In Iowa it is local but occurs in woods along the larger streams, at Des Moines, Boone, Ames and Missouri Valley. The water courses have been important factors in the distribution of our trees and shrubs. Of the trees disseminated by birds, the *Celtis occidentalis*, a species of *Cornus*, the *C. paniculata*, *C. candidissima*, *Vitis riparia*, *Rhus toxicodendron*, *R. glabra*, *Amelanchier canadensis* and *Rosa blanda* are of wide distribution. The *Symphoricarpos vulgaris* and *S. occidentalis*, *Cornus stolonifera*, *Vitis cinerea*, *Rhus venenata*, *Morus rubra*, *Vaccinium macrocarpon*, *V. pennsylvanicum*, *Gaultheria procumbens*, *Arctostaphylos uva-ursi* and *Viburnum opulus* are annual, of somewhat local distribution; very local indeed are the cranberry, blueberry, bearberry and poison oak (*Rhus toxicodendron*), *Vitis cinerea* and the two species of *Symphoricarpos*, one, the *S. vulgaris*, is southern, while the other is northern, quite as common in the Rockies as in Minnesota and Wisconsin. In Wisconsin and southeastern Minnesota it is found upon the bluffs. In Iowa it is abundant upon the loess soil upon the Missouri and the borders of the lakes in northern Iowa.

The seeds of this have no doubt been widely scattered by birds, but it was only when conditions were favorable that growth occurred. Now, if we take into account wind-disseminated shrubs and trees, the conditions for wide scattering are less favorable. Most of our streams in the area are considered to flow in a southeasterly direction. This is true at least of the larger streams. The Mississippi River, although somewhat tortuous, is, however, an important exception. Our winds are either from the north, south, east or west, and it is rather exceptional to have the winds blow any great length of time from the southeast or northwest, hence the chances for scattering of seeds for great distances along the streams are less favorable, except on the Mississippi. Of the wind-disseminated trees the more important are the willows, the *Salix cordata*, *S. amygdaloides* and the shrubby willows, which

are generally common along the streams. The cottonwood, *Populus monilifera*, is found in all parts of the state, except the very small tributaries. By nature the tree prefers alluvial soil. However, since the settlement of the state, the species has become more or less widely scattered in railroad cuts, gravel beds and stone quarries.

FIG. 42. Common Polypody (*Polypodium vulgare*). Sandy rocks and ledges of Boone county, Iowa. Photograph by Charlotte M. King.

Other animals have aided in the dissemination of some of our trees and shrubs. There can be no doubt that the genera *Quercus*, *Juglans* and *Carya* are largely disseminated by squirrels, and in former times larger animals no doubt also helped to disseminate *Rubus strigosus*, *Amelanchier canadensis*, *Arctostaphylos* and *Vaccinium*. These plants show the same northbound and southbound movements that the bird- and wind-disseminated plants do.

The other species of *Populus*, the seeds of which are scattered by the wind, may be mentioned, viz., the *Populus tremuloides* and *P. grandidentata*, the former more abundant in northeastern Iowa, Wisconsin and Minnesota than in central Iowa. It is the only species native around the swamps in Cerro Gordo and Worth counties. The *P. grandidentata* is abundant everywhere in Wisconsin, Minnesota and northeastern Iowa, and reaches over into Hardin and Boone counties, common only upon the carboniferous sandstone in central Iowa, while in Wisconsin and Minnesota it is common upon the St. Croix sandstone.

SOME COCCIDAE FROM THE PHILIPPINE ISLANDS.

BY T. D. A. COCKERELL.

So far as I am aware, only one Coccid has hitherto been recorded from the Philippine Islands, namely, *Chrysomphalus rossi*, from Manila (Proc. Acad. Nat. Sci. Phila., 1899, p. 274). The collection now reported on was obtained by Professor C. H. Tyler Townsend, who in former years discovered so many new Coccidæ in Mexico. Being quite familiar with the group, he knew what to look for, and as I expected, the results are highly satisfactory. While the number of new species is considerable, there are no new genera; but practically everything came from cultivated plants, and it may well be that an examination of the recesses of the native forests will yield more highly characteristic endemic forms.

Monophlebulus townsendi, n. sp.

♀ Grey, flattened, $9^{mm.}$ long, 7½ broad, about 3 high, when dry; the true color is very dark reddish, the grey appearance resulting from the mealy covering; there is a well-defined dorsal area, about $4^{mm.}$ broad, marked in the abdominal region by strong transverse ridges representing the segments; anal orifice plainly visible with a lens, on the dorsal surface about $2½^{mm.}$ from hind end; it is small and round, about 168μ diameter, hairless.

Legs and antennæ black; legs very stout; middle of abdominal region deeply concave beneath, the sides (broad marginal area) densely covered with white cottony tomentum; mouth parts visible in the form of a projecting dark cone; anterior margin of body emarginate and from the emargination arise some long coarse blackish bristles. Antennæ about as long as femur and trochanter of middle leg, i. e. about $1½^{mm.}$; six joints, 3 to 6 about equal, each about 300μ long; 2 shorter and considerably stouter; first joint broader than long; the joints have coarse pale

yellowish bristles, very numerous on the last two. Eggs, raspberry color, about 765μ long.

Batangas, Sept. 20. Peculiar for the six-jointed antennæ in the adult. The only other known species of the genus is Australian.

Icerya candida, n. sp.

♀. With ovisac about $7^{mm.}$ long (perhaps longer when quite perfect), ovisac not grooved; all the secretion pure white, densely covering the body; there are some white glassy filaments, but they are not numerous; antennæ dark red-brown, 11 jointed, about 900μ long; joint 4 shortest, being much broader than long; 11 long and slender and much the longest; 2 and 3 about equal and much longer than any of the joints between 3 and 11; 8 to 10 longer than broad; 1 very broad. Legs ordinary, dark reddish, anterior femora stout.

Young with six (three pairs) of extremely long caudal bristles, longer than the body; long lateral hairs not differentiated into two series, but about equally variable in length all round body; antennal club stout, with long bristles, one of them about as long as whole antenna. Apex of abdomen not emarginate.

Manila, June 4, on a cultivated tree with large oblong-ovate rough leaves. The adult has the last antennal joint obviously longer than the two before it combined and it is much longer than Douglas figures for *I. ægyptiacum*. The larva belongs to the *I. purchasi—seychellarum—ægyptiacum* group; the lateral hairs are very much longer than those shown in Douglas's figure of *ægyptiacum*.

Icerya seychellarum (Westwood).

Lucban, Tayabas, Luzon, March 30, 1904, on cultivated rose; Manila, June 1, on cultivated guava. A parasite was bred from the Manila specimens and sent to Dr. Ashmead, who will describe it as *Parasaphes townsendi*, n. sp.

Pseudococcus lilacinus, n. sp.

♀. Globose, densely covered with white meal, when mounted subglobular, about 1800μ long; after boiling in caustic potash, the pigment in the body is lilac; legs fairly short, anterior leg with femur and trochanter 200μ long, tibia 100, tarsus 65; hind leg,

femur and trochanter 245, tibia 150, tarsus 70, width of femur 65μ; claw stout, simple. Antennæ 8-jointed, length of joints in μ (1.) 25-55, (2.) 32-52, (3.) 37-50, (4.) 20-45, (5.) 25-42, (6.) 27-30, (7.) 30, (8.) 80. In one instance joint 3 measured 73, evidently being combined with 4. Larva in body of female about 375μ long. Lucban, Tayabas, April 10, 1904, on cultivated orange.

I supposed at first that this must be *P. filamentosus*, but that is quite different by the blue-green pigment after boiling and the antennæ are also different. On account of the pigment, it is equally excluded from *P. albizziæ*. By the purplish pigment and general appearance it resembles *P. quaintancii* (Tinsley); it is also rather near *P. texensis* (Tinsley) and *P. comstocki* (Kuwana). The antennæ are very variable, but the series of measurements 25, 45, 45, 22, 25, 30, 30, 80, expresses what I take to be the more normal lengths of the joints.

Pseudococcus tayabanus, n. sp.

♀. Covered with mealy secretion, distinctly segmented, looking (when dry) like minute specimens of commerical cochineal; when mounted oval, about 1500μ long; after boiling, the body is seen to contain much dull crimson pigment, especially in the embryonic young; eyes well-developed; anal ring with six hairs, and placed in a wide squared incision; lateral margins of segments projecting, so that the margin is strongly undulated, the projecting points bear stout spines, about 12μ long; skin greatly crowded with round glands; labium long and narrow, about 150μ long and 70 broad; legs stout, length of tibia about 125μ (counting from middle to middle), tarsus 75; claw stout, simple; antennæ 8-jointed, joints measuring in μ (1.) 50, (2.) 50-62, (3.) 50-52, (4.) 25-27, (5.) 33-40, (6.) 40-45, (7.) 37-40, (8.) 87. The smaller measurements (50) for two appears to be normal.

Larva with longitudinal rows of bristles (not spines), the middle row double; six stout hairs on anal ring; claw long, simple; antennæ 6-jointed, joints measuring, (1.) 20, (2.) 22, (3.) 17, (4.) 17, (5.) 22, (6.) 52-55. Joint 8 bears three whorls of hairs, and ends in a stout blunt cone.

Lucban, Tayabas, April 7 and April 20, 1904, on cultivated cacao.

A peculiar species, in many respects like *P. texensis* (Tinsley). The antennæ are not unlike those of *P. comstocki* (Kuwana), but that has joints 4 and 5 not very different in length.

Pseudococcus virgatus (Cockerell), variety.

♀. Secretion full of glassy filaments; anterior leg with femur and trochanter 292μ long, tibia 212, tarsus 89; claw rather long, simple; antennæ 8-jointed, 8 with three whorls of hairs; joints measuring (1.) 50, (2.) 63-65, (3.) 70-72, (4.) 37-42, (5.) 40-45, (6.) 45-47, (7.) 45-47, (8.) 100.

Lucban, Tayabas, April 20, 1904, on cultivated croton.

Typical *virgatus*, from Jamaica and Ceylon, is larger, with the third antennal joint considerably longer. The antennæ of the Philippine insect practically agree with those of *P. kraunhiæ* (Kuwana), and I should not be surprised if the two proved identical, though Kuwana does not allude to any glassy filaments. Kuwana says that *kraunhiæ* has the tibia three times as long as the tarsus, but his figure contradicts this. Our insect also shows some resemblance to *P. magnolicida*. Whether or not it is identical with anything described, I think it is undoubtedly a variety of *P. virgatus*.

Saissetia nigra (Nietner).

Manila, May 19, on cassava run wild.

Saissetia oleæ (Bernard).

Lucban, April 11, 1904, on cultivated plant called "rosal" or "campopot."

Saissetia hemisphærica (Targioni-Tozzetti).

Lucban, April 11, 1904, on cultivated sago palm, and on two undetermined cultivated plants.

Coccus longulus (Douglas).

Lucban, April 20, 1904, on cultivated "macetas," a croton with oak-like white-spotted leaves.

Coccus diversipes, n. sp.

♀. Scale light reddish-brown, quite flat, broad-oval, the anterior end narrowest; length $2\frac{1}{4}$-$2\frac{2}{3}$ mm., breath about 2; surface

marked with many large irregularly shaped polygonal areas, about 60 to 150μ diameter, in each of which is a smaller area of the same general form, and within this sometimes a smaller and occasionally a smaller within that; these areas are marked merely by contour-lines, which show little marginal cracks; they are not destroyed by boiling in liquor potanæ, but they become wholly invisible when the insect is mounted in balsam; the regions between these areas show numerous small gland-spots, which appear blackish. Anal plates long and narrow, 187μ long, and together 130 wide, posterior lateral side 87 long, anterior lateral side 150 long, tip of plates to hind end of body about 750μ.

Anterior legs ordinary, femur and trochanter 145μ long, tibia 80, tarsus 50, the femur not especially slender, its diameter about 45μ. Middle and hind legs remarkably slender and elongated, with very large coxæ; measurements in μ :—

	Femur and Trochanter.	Tibia.	Tarsus.	Width of Femur.
Middle legs...............	250	105	42	41
Hind legs................	265			41

Antennæ 6-jointed, joints measuring (1.) 30, (2.) 37, (3.) 97, (4.) 27-30, (5.) 25-27, (6.) 55. Joint 3 is slender and smooth, with a whorl of bristles 80-84μ from base; 6 is slender, with several long bristles. Marginal hairs strongly fimbriate or branched, about 20μ apart.

Lucena, Tayabas, April 24, 1904, on cultivated fern "parasite."

Very close to *C. acuminatus* ("Signoret") of Green, but not identical; also close to *C. incisus* (King), but that has 8-jointed antennæ. The antennæ of *C. diversipes* are almost exactly like those of *C. rhizophoræ* (Cockerell), and are very similar to those of *Eucalymnatus gracilis* (Hempel), but these insects are otherwise different.

Pulvinaria polygonata, n. sp.

♀. Light brown; ovisac pure white, broad and fluffy, irregular in form; mounted female a little over $3^{mm.}$ long and 2 broad; skin with an irregularly polygonal structure like some *Saissetia*, only the walls of the spaces are perfectly hyaline and colorless, the spaces are about 25μ diameter; mouth-parts small; marginal spines about 30μ apart, long, stout, more or less branched at end, but not greatly broadened; stigmatal spines ordinary; anal plates

together forming nearly a square, their length and breadth (of the two together) each about 137μ. Anterior leg measuring, femur and trochanter 215, tibia 150, tarsus (without claw) 75; claws hooked, their digitules fully twice their length, with very large knobs. Antennæ 8-jointed, 5 with a very long bristle; joints measuring, (1.) 50, (2.) 52, (3.) 75, (4.) 57, (5.) 50, (6.) 30, (7.) 30, (8.) 50.

Manila, June 3, on leaves of a cultivated shade-tree, accompanied by a species of *Aleyrodes*.

P. tessellata, Green, has the dermal markings, but it has a bright green fluted ovisac; *P. aurantii*, Cockerell, has similar antennæ, but quite different marginal spines, etc.; *P. eugeniæ*, Hempel, has also similar antennæ, but a different ovisac; *P. tecta*, Maskell, has the dermal markings, but the marginal spines are simple; *P. simplex*, King, has polygonal dermal markings, but otherwise is different.

Pulvinaria tyleri, n. sp.

♀. Smallish, light brown, with a loose, shapeless fluffy white ovisac; mounted female about 1865μ long (full of eggs, which are very large, 570μ long); stigmatal spines in threes, the long ones stout and 60μ long, the short about 15; marginal spines stout, not close together, simple or very slightly bifid at end; legs ordinary, measurements of anterior legs; femur and trochanter 220, tibia 168, tarsus (without claw) 92. Antennæ 8-jointed; measurements of joints:—(1.) 40, (2.) 62, (3.) 70, (4.) 40, (5.) 40, (6.) 27, (7.) 22, (8.) 50.

Batangas, April 7, 1905, on "cadena de amor," crowded on the twigs. Quite distinct from *P. psidii* and *P. aurantii*.

Pulvinaria psidii philippina, n. subsp.

♀. Scales and ovisacs matted together in great confusion; marginal hairs about 50μ apart, broad and flattened at end, the margin of the flattened part slightly fimbriated; tibia 225-262μ long, tarsus 110-117; claw digitules long, with large round knobs, 12μ diameter; bristles of anal ring stout, 200μ long; anal plates ordinary, length 140, anterior lateral margin 87, posterior lateral margin 107. Antennæ 6-jointed, joints measuring, (1.) 50, (2.) 50-57, (3.) 100-105, (4.) 50, (5.) 67, (6.) 95. Joints 2 and 5 each with a very long bristle.

Lucena, Tayabas, April 20, 1904, on a cultivated *Ficus*.

The long tibia, long third antennal joint, marginal hairs, long bristles on joints 2 and 5 of antennæ, etc., all show this insect to be very close to *P. ficus*, Hempel, and *P. psidii*, Maskell. The six-jointed antennæ are distinctive, but may not be constant. It is evidently reasonable to treat the insect as a subspecies of *psidii*, and so far as I can make out *P. ficus* should stand as *P. psidii ficus*.

Aspidiotus simillimus translucens, Cockerell.

Lucban, Tayabas, April 19, 1904, on cocoanut seedling. Length of female 750μ or rather more; anterior lateral glands 7, posterior laterals 4-5, in a group.

Aspidiotus lataniæ, Signoret.

Lucban, Tayabas, April 6, 1904, on cabbage.

Aspidiotus tayabanus, n. sp.

♀. Scales crowded on bark, not distinctly separable, flat, dark ferruginous, exuviæ marked by a distinct dot and ring in grey or yellowish-white, but on rubbing, the second skin appears, bright orange-ferruginous or orange-chestnut; there is a thin whitish ventral film.

Female insect light yellow (after boiling), reniform; no circumgenital glands; dorsal pores few and small; genital orifice about 30μ anterior to anal orifice, its margin thickened; anal orifice about 7μ long, oval, distant about 30μ from tips of median lobes, two pairs of lobes, close together, the median lobes large and elongated, their inner sides practically contiguous, the apex rounded, the outer margin with a strong notch; second lobes of the same general shape, but very much smaller, more pointed, with the notch stronger; spines rather large; a short distance beyond the second lobe the margin presents two little pointed projections, and beyond that come three large broad strap-shaped squames, their ends or sides with a few linear processes; then two more small pointed projections, and beyond that a very fine serrulation of the margin. In the interval between the first and second lobes are two long club-shaped glands or "paraphyses,"

the inner about twice as long as the outer, its rounded end extending beyond the level of the anal orifice.

Lucban, Tayabas, April 11, 1904, on cultivated plant called "rosal" or "campopot," with *Saissetia oleæ*.

Allied to *A. moorei*, Green, and by the club-shaped organs suggesting *A. quadriclavatus*, Green, and *Pseudaondia clavigera*, Cockerell. The lobes are curiously similar in form to those of *A. forbesi*, Johnson.

Pseudaonidia trilobitiformis (Green).

Manila, May 7, 1904, on *Artocarpus*.

Chrysomphalus rossi (Maskell).

Lucban, Tayabas, March 30 and April 19, 1904, on cultivated sago palm; Lucban, March 30, 1904, on "Nangcanongcaong," cultivated.

Chrysomphalus aonidum (Linné).

Manila, June 5, on cultivated banana; Manila, May 7, 1904, on *Artocarpus*; Manila, June 5, on large spreading palm, cultivated, and May 19, on native palm (like *Oreodoxa*), cultivated.

Chrysomphalus aurantii (Maskell).

Manila, May 7, 1904, on *Artocarpus*.

Parlatoria proteus (Curtis).

Manila, June 5, on *Eugenia malaccensis*, cultivated.

Parlatoria pergandii (Comstock).

Manila, May 19, on aloe-like plant, cultivated. The scales look like *proteus*, but the fourth lobe of *pergandii* is very distinct.

Aulacaspis rosæ (Bouché).

Lucban, Tayabas, on rose, cultivated, March 30, 1904. A variety with the second skin black, tipped with light reddish.

Phenacaspis eugeniæ (Maskell).

Manila, June 5, on a large spreading palm, cultivated. This seems to be *eugeniæ*, but it will be more critically examined by Professor Cooley, who is revising the genus.

Hemichionaspis townsendi, n. sp.

♀. Scale light greyish or yellowish, exactly the color of the back on which it rests, the exuviæ a little yellower; shape pyriform, rather broad, varying to nearly circular.

♂. Scale white, bluntly tricarinate, the exuvia very pale yellowish.

♀. Color after boiling light yellowish, with some blue pigment at the cephalic end; length of mounted example 672μ, breadth 600, the insect therefore shorter than usual; sides of segments bulging, forming on each side about four large rounded prominences; eggs in body of female (well-developed with eyes showing) 155μ long; five groups of circumgenital glands, median about 16, anterior laterals about 19 or 20, posterior laterals about 25; anal orifice round, about 12μ diameter, and 112 from tips of median lobes; dorsal glands not very numerous; median lobes contiguous, low and broad (about 12μ long, the two together 22 broad) with four crenulations produced by three notches, the first two being very deep and strong; second lobes quite rudimentary, not or hardly rising above general margin; first spine-like squame small, but the others (three single ones at rather long intervals, and then a pair) very large and long.

Lucban, Tayabas, on bark of *Gossypium*, April 12. The male scales are in groups and conspicuous, but the female scales are so inconspicuous that I very nearly overlooked them. The notches of the median lobes are considerably deeper than in any species figured on Cooley's Pl. IX. The rudimentary second lobes afford a character to distinguish the species from *H. theæ* and *aspidistræ*.

Lepidosaphes cocculi (Green).

Manila, June 5, on large spreading cultivated palm. Probably some forms from elsewhere, found on palms and recorded as *L. gloveri*, may have been this.

Lepidosaphes rubrovittatus, n. sp.

♀. Scales broader than *gloveri*, but narrower than *ulmi* or *beckii*, and of a peculiar greenish-yellow or yellowish-green color; the exuviæ dull orange, with a dark red longitudinal stripe down the middle of both skins. Circumgenital glands close together,

the groups forming a sort of broad V, exactly as in *L. serrifrons;* median group of 3, anterior laterals 7 to 8, posterior laterals 4; dorsal glands conspicuous; anal orifice small, about 82μ from hind end; three segments before the terminal area produced laterally, and bearing spines; anterior end with the skin finely striate, but not in the least provided with the spines or projections of *serrifrons;* lobes, etc., similar to those of *serrifrons;* third lobe (second lobule of second) more or less rudimentary, so that it is not readily noticed; median lobes striate, slightly notched on each side, and very slightly inclined to be crenulate; squames all spine-like and simple; marginal oval fusiform gland-orifices very distinct, as in *ulmi*, etc.

Manila, June 5, on cultivated *Eugenia malaccensis*, with *Parlatoria*.

This insect belongs to a group consisting of *L. gloveri*, (Packard), *L. pallida*, (Green), *L. pallida maskelli*, (Cockerell) and itself. It is nearest to *maskelli*, and is perhaps only a variety or race of it, *maskelli* itself being probably a species distinct from *pallida*.

THE COMMON DRONE-FLY

(Eristalis tenax Linn.)

Its Prevalence in the Old World, Probably for Centuries, from the Atlantic Ocean to Japan, and the Remarkable Circumstances of its Sudden Invasion of the New World (North America and New Zealand) Between the Years 1870 and 1888.

BY C. R. OSTEN SACKEN

It has been truly said that "chance is the *incognito* of Providence," and I am involuntarily reminded of this saying when I recall the succession of chances which have enabled me to witness the extraordinary history of the invasion of the common drone-fly (*Eristalis tenax* Linn.) into the continents of the New World.

Eristalis tenax had been known for centuries to occur in most of the temperate regions of the Old World, from the shores of the Atlantic Ocean across all Europe through Siberia and China to Japan, but it had never been found in the New World. For twenty years I have been collecting Diptera in North America, north of Mexico, without ever meeting with it. To all appearances, nothing would have been easier than for *E. tenax*, with its aquatic larva, thriving in stagnant and putrescent waters, to have been among the first insects carried across the Atlantic Ocean in one of the innumerable vessels which, for more than four centuries, had been plying between the two continents. That this has never taken place appears to me to add one more to the unsolved problems of the geographical distribution of animals.

It was in November, 1875, that, to my great astonishment, I discovered a specimen of *E. tenax* on a window in Cambridge, Mass., where I resided at that time. Next year I observed specimens in Newport, R. I., and a few years later (when I had already settled in Europe) the species was reported from all the States of

the Union and also from Canada. Further inquiry proved that the fly had not been imported across the Atlantic Ocean, but that it had wandered across the continent from the west, and that it had been observed in St. Louis before 1870. The natural inference from these facts was that it had been imported from Japan to the Pacific Coast, perhaps long ago, and had spread eastward much later, when the necessary conditions for its existence (drains, cesspools, sewers, etc.) had been gradually introduced by civilization across the immense plains which separate the Pacific from the Atlantic Ocean.

Still more astonishing was the almost contemporaneous appearance of *E. tenax* in New Zealand. It had never been found there until it was suddenly discovered in the North Island in 1888, and became widely dispersed in both islands two years later. How is it that, after the failure of *E. tenax* to cross the Atlantic Ocean during nearly four centuries, it reached New Zealand by a sudden leap, probably by way of California, across a distance at least twice as great as that between Europe and North America? The intervening islands of the Pacific Ocean may have served as a bridge to it (it was found in the Sandwich Islands in 1892: comp. Grimshaw, Fauna Hawaiiensis, p. 19); still, the simultaneousness of the invasion of such distant regions of the New World within such a brief period of time remains an extraordinary and, it seems to me, unexplained phenomenon. It affords me no mean satisfaction to have had the privilege of witnessing and putting on record the history of this invasion.

NOTE.—*E. tenax* had not been found in South America as late as 1893. About its occurrence on the continent of Australia I have no positive data. (Compare my essay: "On the Oxen-born Bees," etc., 1894, p. 37.)

To trace the rôle of *E. tenax* in past times we must look for it among the mentions of *bees* in history, because this fly, in olden times, was invariably mistaken for a bee. From the frequent occurrence of *E. tenax* in the vicinity of carcasses of dead animals, and especially of oxen, the ancients concluded that bees could be produced artificially from dead oxen. This was called *apes facere* (to make bees), and thus the term Oxen-born Bees (*bugenes melissæ* in Greek and *taurigenæ apes* in Latin) became of common use in ancient literature. The method consisted in burying the carcass of an ox and thus producing what was believed to be bees;

but nobody took the trouble of verifying whether these "bees" ever made honey.

This absurd notion prevailed not only among the ancients; it persisted through the middle ages, up to comparatively recent times. The celebrated Italian naturalist, Aldrovandi (1602), the Englishman, Moufet, (Theatrum insectorum, 1634,) the learned Frenchman, Bochart, (Hierozoicon, 1664,) and other authors of that time considered the practice as a matter of every-day experience. The final confutation of this craze took place when, with the progress of natural science, the belief in spontaneous generation upon which it was based was abandoned and replaced by the doctrine of evolution, represented by the formula: all life begins with an egg (*omne vivum ex ovo*) proclaimed by later naturalists, by the Englishman, Harvey, (1651) and the Italian, Redi, (1668).

Under the heading "On the Oxen-born Bees of the Ancients (Bugonia) and Their Relation to *Eristalis tenax*, a Two-winged Insect" (xiv + 80 pages; Heidelberg, J. Hörning, 1894), to which in 1895 I added "Additional Notes In Explanation of the Bugonia-lore of the Ancients" (ibidem, 23 pages), I published an elaborate research upon the whole question, based upon more than one hundred references to the existing literature. I concluded the first of these essays (p. 37) with the following words:

"Except the silkworm and the honey-bee, I hardly know of any insect that can show an historical record equal to that of *Eristalis tenax*. The record begins in the dusk of prehistoric times, and continues up to the present date. In its earliest days *E. tenax* appears like a myth, a misunderstood and unnamed being, praised for qualities which it never possessed, a theme for mythology in prose and poetry; later on, the bubble of its glory having burst, it gradually settles into a kind of commensalism with man, it obtains from him 'a local habitation and a name,' it joins the Anglo-Saxon race in its immense colonial development, it vies with it in prodigies of fecundity, and at present renders hitherto unrecognized services in converting atrocious 'stuff' into pure and clean living matter!"

In the Book of Judges, XIV, the story of Samson (who, after killing a lion, found, some time later, a hive of bees in the carcass and ate the honey) has been for centuries a puzzle for interpreters. Professor Max Müller, at Oxford, saw a *solar myth* in it,

like the story of Hercules, to which he attributed a similar origin. (The same explanation is found in the recent novel of B. Björnson, "Auf Gottes Wegen.") A more natural explanation was offered by me in my work on the Bugonia (p. 18) that Samson's bees were carcass-born flies, *Eristalis tenax*. Dr. Adalbert Merx, Professor of Scriptural Exegesis in Heidelberg, accepted this interpretation with joy, as it proves the truth of an otherwise incredible story. The hive and the honey were, in this case, a stretch of imagination of the story-tellers (l. c. p. 62–68. I have reproduced in English translation Prof. Merx's article on this subject).

I closed my chapter on the Bugonia-lore of the ancients with a sentence of Goethe (l. c. p. 38).

"Man sieht nur was man weiss."

NOTES ON SOME IOWA PLANTS.

BY B. SHIMEK.

Recent discoveries of species new to the state, and the segregation of forms hitherto confused with other species, have added materially to our known state flora, and the latter cause has resulted in the elimination of names heretofore applied to species which are now considered distinct. In the following notes a brief discussion of some of these interesting cases is presented.

Ricciocarpus natans (L.) Corda. This floating liverwort was found by the writer in great abundance in a pond near Scarville, Winnebago county, late in the fall of 1902. It is here reported for the first time from the state.

Woodsia ilvensis (L.) R. Br. The discovery of this interesting fern in Iowa was reported by the writer at the St. Louis meeting of the A. A. A. S. last winter. It was found upon exposures of St. Peter sandstone in Winneshiek county. Mr. O. M. Oleson has since submitted specimens which were collected at Ft. Dodge. It has been known from Wisconsin and Minnesota, but is new to Iowa. Its occurrence, therefore, at two such widely separated localities in the state, is of special interest. In Winneshiek county it was found at two points near Hesper, both about half a mile from the state line.

Smilax pseudochina L. This species, and *S. hispida*, with which it has been confused, are our only native woody endogens. Well-defined specimens of this species were collected by the writer in Cerro Gordo county, and by Mr. J. E. Cameron in Delaware county. It will probably be found widely distributed in the state. It was reported in Vol. 38 of the Transactions of the Iowa Hort. Society, p. 461.

Salix missouriensis Bebb. An interesting form of this species was collected on the sand-dunes west of California Junction, Harrison county, May 19th, 1903. Fruiting specimens were then

common, but most of the capsules had dehisced. Several shrubs and small trees still bore staminate flowers. In this habit of producing staminate flowers irregularly through spring and early summer, this species resembles *S. rivularis.* The specimens on the sand-dunes are dwarfed, more or less tufted or clustered, and approach *S. glaucophylla* Bebb, both in the character of the leaves and the style. Twigs which were grown in water, however, developed leaves characteristic of *S. missouriensis.* Leafless staminate and pistillate twigs, collected at the same place by Messrs. Bruce McGavern, David Moore, and P. Tierney, April 18, 1904, later developed typical leaves of *S. missouriensis*, but the pistillate flowers showed a distinct, rather slender style, thus approaching *S. glaucophylla.* The latter species occurs on the sand-dunes along Lake Michigan, and is evidently closely related to *S. missouriensis*, if, indeed, it does not connect with it.

Populus candicans Ait. Native, or if introduced, well-established, on river bluffs in Winneshiek county, especially along the Upper Iowa above Kendallville. While this has been cultivated quite commonly it has not heretofore been recognized as belonging to our flora.

Corylus rostrata Ait. Much doubt has been entertained concerning the occurrence of this species in Iowa, but the writer found it sparingly in the vicinity of Kendallville, Winneshiek county, in 1903. Several specimens were observed on rather low ground at the base of a shaded rocky slope.

Quercus borealis Mx. f. This is the common black oak of higher dry grounds in the northern part of Winneshiek county. It has thin, very brittle bark; the leaves are small and regularly lobed, like those of the red oak though rather more deeply, and the acorns are intermediate in their character between those of *Q. rubra* and *Q. velutina.* The inner bark is light yellow, and very brittle. Some of the phases of this species approach *Q. schneckii* which is more common in the north-central part of the state. Our Iowa forms agree well with Engelman's specimens of *Q. ambiqua* Mx. f. (*Q. borealis*) in the Shaw herbarium at St. Louis.

Asarum acuminatum (Ashe) Bicknell. This and the following species were formerly included under *A. canadense* L., a

species which does not occur in the state. All published references to *A. canadense* are, therefore, valueless so far as concerns this state. *A. acuminatum* is the common species of mossy, shaded, rocky banks, and is readily recognized by its long-acuminate calyx-lobes. The herbarium of the State University contains specimens from Emmet county (*R. I. Cratty*), Delaware county (*J. E. Cameron*), Dubuque county (*J. A. Anderson*), and from Johnson and Cerro Gordo counties, collected by the writer. This is the more common *Asarum* of the northeastern part of the state.

Asarum reflexum Bicknell. This species is readily recognized by its smoother surface, and shorter, reflexed calyx-lobes, as well as by its habit. It grows in low, rich alluvial woods, in company with *Claytonia virginica*, *Isopyrum biternatum*, *Cardamine purpurea*, etc. The University herbarium contains specimens from Polk county (*E. Des Moines Highschool*), Pottawattamie county (*J. E. Cameron*), Wayne county (*F. A. Stromsten*), Muscatine county (*Ferd. Reppert*), and Johnson, Muscatine, Monroe, Appanoose, and Cerro Gordo counties, collected by the writer.

Polygonum camporum Meisn. This and the following species were also reported at the St. Louis meeting of the A. A. A. S. This species has heretofore been confused with *P. ramosissimum* Mx., but is very distinct. It is found upon sandy ridges in Winnebago county, and westward.

Polygonum douglasii Greene. This is locally very common on St. Peter sandstone exposures in the northern part of Winneshiek county, where it grows on sandy talus with the comparatively rare *P. tenue* Mx. Flowering specimens were abundant in August, 1903.

Talinum parviflorum Nutt. This was reported* by the writer from Lyon county as *T. teretifolium*, but our specimens are undoubtedly *T. parviflorum*. Arthur also reported *T. teretifolium* from the same locality in Lyon county,† and probably made the same error. The species is locally rather common at two points near the northwest corner of the state, where it grows on Sioux Quartzite exposures, in crevices and upon the scant dry soil which accumulates in places upon the rock.

* Ia. Geol. Sur., Vol. X, p. 175; Proc. Ia. Acad. Sci., Vol. IV, p. 73.
† Proc. Dav. Acad., Vol. III, p. 169.

Brasenia purpurea (Mx.) Casp. This species, better known as *B. peltata* Pursh, was collected by the late Ferd. Reppert in Muscatine county, and was reported in the Proc. of the Davenport Acad. of Sciences, Vol. VIII., p. 202. This was the only record of its occurrence in this state until the writer discovered it growing commonly in Dead Man's Lake, in the northeast corner of Hancock county, during the last week of September, 1902. It was then fruiting abundantly.

Atragene americana Sims. This species, hitherto known from Winneshiek and Delaware counties only, was recently reported in the Trans. Iowa Hort. Society (l. c.). It is found sparingly upon rocky bluffs and banks in the northwestern part of the county, and probably occurs in the adjoining portions of both Delaware and Clayton counties. Its conspicuous flowers appear about the middle of May.

Ribes missouriensis Nutt. This species was also reported with the preceding, but without specific localities. The University herbarium contains specimens from Pottawattamie county (*J. E. Cameron*), and from Harrison, Lyon, Webster and Johnson counties, collected by the writer. It was formerly confused with *R. gracile*, and seems to be the more common species, especially westward.

Opulaster intermedius Ryd. This form grades more or less into *O. opulifolius* (L.) Kuntze, and is probably a mere illustration of the tendency of some species to develop xerophytic characters, such as increased hairiness of the surface, etc., as they extend westward into the drier, more open prairie portions of the state. Specimens referable to this form were collected by the writer in Johnson county.

Rubus baileyanus Britt. This species was also reported in the Trans. Iowa Hort. Society, l. c., p. 463, where a typographical error assigns it to the southeastern part of the state. The specimens there reported were collected in Winneskiek county. The species has since been collected by the writer near Unionville, in Appanoose county, where it grows on moist banks in rather deep woods.

Potentilla tridentata Sol. This species was first reported in Iowa from Hesper, Winneshiek county, by Arthur,* and is still

* Proc. Dav. Acad. Sci., Vol. III., p. 169.

very common on the St. Peter sandstone exposures northeast of Hesper. Fruiting specimens were common in August, 1903, and the leaves were afflicted with a *Phragmidium*, probably *fragariæ*, a new host for this fungus in Iowa.

Aronia nigra (Willd.) Britt. This species was also recently reported by the writer,* together with the following species with which it was found growing on exposed ledges of St. Peter sandstone northeast of Hesper. Some of the specimens were in fine fruit in August, 1903.

Prunus pumila L. Found with the preceding. It is rare, only a few plants being found on the most exposed parts of the sandstone ledges.

Scrophularia marylandica L. This and the following species were formerly called a variety of *S. nodosa*. They differ both in structure and in habit. This species is readily recognized by its deep purple abortive stamen, and by the more puberulent lower surface of the leaves. It is found more frequently in woods and on lower grounds. The University herbarium contains specimens from Jones county (*J. E. Cameron*), and from Johnson, Cerro Gordo, Lyon, Winneshiek and Lee counties, collected by the writer. Earlier records of this species in the state are of little value, because they undoubtedly in part include the following species.

Scrophularia leporella Bick. This differs from the preceding species in having a greenish-yellow abortive stamen, and smoother leaves. It grows more commonly on the prairie, and in openings and along borders in wooded country. The University herbarium contains specimens from Johnson, Floyd and Winneshiek counties, collected by the writer. It is, however, much more widely distributed than this would indicate.

* Trans. Ia. Hort. Soc., Vol. XXXVIII, p. 466.

MURAL RELIEF FIGURES OF EL CASA DEL TEPOZTECO

BY J. WALTER FEWKES

On a recent visit to Mexico the author made an excursion to Cuernavaca in order to visit[1] the wonderful ruin called Xochicalco in the state, Morelos. He likewise visited the little-known temple, El Casa del Tepozteco, situated in the mountains above the Indian pueblo, Tepoztlan. The mural figures described in the following pages occur on the walls of the latter ruin.

In order to visit this ruin the author and a companion[2] left the railroad between Mexico and Cuernavaca at the station called El Parque, which is nothing but a solitary train house on the mountains. A short walk from this place brought us to the Cerro del Tepozteco, on the apex of which, a thousand feet above the plain, could be readily seen the ruined temple appearing as a white spot on the side of the mountain.

After a climb up one of the most precipitous cliffs[3] known to him, with the exception possibly of some parts of the old trail from the Colorado River to the rim of the Canyon, the author reached the summit of the mountain, where a camp was made in the thatched cabin of the Custodian. In this elevated pinnacle the author and Dr. Le Baron remained over night and the greater part of two days, which were profitably occupied in a study of the monument and its various parts. Several good photographs and a few notes were obtained on this short visit, but the data

1. This article is published by permission of the Secretary of the Smithsonian Institution.

2. The author was accompanied on this excursion by Dr. Eugene Le Baron of Cuernavaca, to whom he is indebted for many kindnesses, including the photographs reproduced in plates I-III.

3. This trail has been much improved of late by the introduction of iron ladders and platforms so that the difficulties in following it have been much reduced.

most prized is a series of drawings of certain figures on the banquette of the interior walls made by the Custodian, Sr. B. Verazaluce. On comparing these drawings with the original reliefs on the temple walls their fidelity in minute details was apparent, and later, when it was possible to consult existing descriptions and photographs of the ruin, it was recognized that this series is more complete than any that have yet been printed. It is especially fitting that this important series should be published not only from its intrinsic value as illustrating the designs, but also because it was made by one of the natives of Tepoztlan pueblo to which we already owe so much in the preservation of their highly-prized ancient monument.

The ruined temple, El Casa del Tepozteco, was formerly introduced to the archæological world by a native of Tepoztlan, Sr. Francisco Rodriguez, the talented engineer who is now Acting Director of the Museo Nacional of Mexico. A brief communication calling attention to the ruin was made at the meeting of the Americanists in Mexico in 1895 and was later[1] published in the proceedings of the session of the year. Under his initiation and personal supervision the Tepoztlan[2] Indians, who take much pride in this ancient monument of their race, cleared away the accumulated debris and improved the trail leading to it from the plain, thus making it accessible to visitors.

Penafiel, in his work on Teotihuacan[3] published in 1900, claims that the Casa del Tepozteco was first described by D. Jesus Quiroz, but gives no reference to the place where this description appeared. He reproduces Saville's illustrations in part and compiles his short description mainly from that of Rodriguez. The account by Penafiel adds little to what was already known of this ruin. Although Sr. Rodriguez's article before the Congress of the Americanists was a brief one it attracted much attention and led several archæologists to visit the temple, and later to the

1. Congress Internacional des Americanistas. Actas de la undecima Reunion. Mexico; pp. 233–237. 1895.

2. On the 7th September, yearly, it is said that the *Teponaxtli* or drum kept in Tepoztlan is carried up to this temple and beaten. On the following morning, at sunrise, certain rites are performed in the temple. There is likewise a personation of the "Rey de Tepoztlan," who receives "Ambassadors" from neighboring pueblos.

3. Teotihuacan. Estudio Historico y Arqueologico, pls. 76, 76.

appointment of a custodian of the ruin. Among others who climbed the precipitous Cerro de Tepozteco under guidance of Sr. Rodriguez, was Professor Marshall H. Saville of New York, who made excellent photographs that he later published[1] in his valuable articles on this subject. One of the important contributions made by Saville to our knowledge of the ruin was a determination of the date of its construction obtained from a slab on which were cut relief figures. This stone was found in the lower stone of the pyramid and later removed to Mexico. A ground plan of the ruin made by Rodriguez also appears in the same work.

Dr. Seler[2] supplemented Saville's account with many important suggestions regarding the patron god to whom the temple was dedicated and the inscriptions on its walls. He likewise identified several of the relief designs here considered, including one not now in place and therefore not considered in our series. This slab formerly occupied what is now a gap in the middle of the east wall and was apparently the key not only to the age but also to the character of the worship in the old temple.

Architecturally the ruin consists of a temple standing on a solid pyramidal base with almost perpendicular sides, the elevation of which is broken by two narrow shelfs or terraces. The superstructure or building on top of the pyramid, which was the temple proper, opened to the west, being approached by two broad stairways, an upper now somewhat dilapidated and a lower rising from a landing to which access was gained from a lower level. The walls of the once roofed temple enclosed two rooms, a rear chamber, which may be called the cella and an anteroom. The former was entered by a passage-way in the partition, occupying the space between offsets arising from the north and south walls. The anteroom contains, besides other structures, the

1. Bulletin American Museum of Natural History, Vol. VIII, Monumental Records, Vol. I. No. 1, July, 1897.

2. Die Temple pyramide von Tepoztlan. Globus, Bd. 73, No. 8, pp. 123-129. Gesammelte Abhandlungen Sprach und Alterthumskunde. Berlin, 1904, 2nd vol., pp. 200-214. The article in Globus is translated, "Temple Pyramid of Tepoxtlan," in Bulletin, Bureau of American Ethnology, No. 28, pp. 341-352. Since these articles were written new excavations have been made in the neighborhood of the base of the temple of Tepozteca and important undescribed walls and other structures brought to light.

remains of foundations and pillars. The structure which especially concerns us in this article is a narrow ledge slightly raised above the floor, extending around the north, south and east walls of the cella, and a part of the north and south walls of the anteroom. It served as a kind of banquette or seat, recalling a similar structure in Hopi kivas. The vertical face of this banquette is constructed of square or rectangular blocks of stone, the surface of which is ornamented with figures cut in low relief. The edge of the seat projects slightly beyond the rise and is also decorated with relief designs. The rock used in its construction is the common building stone of the present day, a kind of lava (*tezontli*). This stone is readily worked and is softer than that used at Xochicalco and some other ruins. The carved relief figures were painted red. The two offsets that stand out from the north and south walls forming the partition separating the cella from the anteroom have no banquettes and are destitute of relief decorations on their east side, although their other surfaces are elaborately ornamented with geometrical relief figures that will not now be considered. There are at present no mural decorations on the walls of the cella or antechamber above the banquette, although remnants of color show that formerly paintings and other ornamentations adorned this part of the wall.

For convenience of reference and description the relief figures are arranged and numbered beginning at the northwest corner of the cella, passing from it to the east or rear wall, then to the south wall, ending in the southwest corner. Then follow the figures on the banquette of the anteroom, where the figures are imperfect and the series incomplete. There are, all told, sixteen figures now present on the upright walls of the cella, four on the north, four on the south, and eight on the rear wall. The number of small relief figures on the projecting edge of the seat is unknown, but there are more than twenty[1] in this position. The original relief figures from which these drawings were made do not follow each other in a continuous series. There is a break directly opposite the entrance into the cella, and at one or two other points, from which stones were removed a short time ago. The position of the former is between numbers 7 and 8; that of the latter is shown in the drawings.

1. No resemblance was noted between these signs and the Mexican day symbols.

The little that has been published on the relief figures of the inner wall of the Casa del Tepozteco is derived from photographs published in Saville's descriptions of the ruin, which appear to have been used in Dr. Seler's interpretations. These photographs show only parts of the series, and in one or two instances are too indistinct for outlines of relief designs.

The author will begin his comments on Sr. Verazaluce's series of drawings with those on the north side of the cella at the northwest corner, where there are four figures, Nos. 1–4, carved in relief on seven stones, six of which are now, 1905, in place, the seventh having been removed later than Saville's visit. According to Dr. Seler, the design No. 1 represents a bundle composed of several objects bound together, having a water or blood symbol issuing from each side. The design No. 2 on the third and fourth stones is identified by the same authority as *atl*, water, with an eye, *ixtli*. The circle here identified by Seler as an eye is elsewhere, No. 4, duplicated and having a somewhat modified form is there identified by the same author as a shield.

An elaborate design, No. 3, on the fifth stone, according to Dr. Seler, represents a pulque bowl with two lateral ring-like appendages. On the middle of the design is depicted the half-moon-formed nose ornament, *yacametzli*, a characteristic ornament of the Pulque god.

No. 4, according to Dr. Seler, represents war, *yaoyotl*, consisting of a shield, spears and banner.[1] The part of this design that is cut on the sixth stone shows the points of the spears. The symbol in the lower right-hand corner represents *blood or water*. Apparently Dr. Seler had no available material adequate for the identification of the relief figures on the east wall, for he does not discuss the designs that are found in this place.

The relief on the east banquette are well made and apparently significant as their position would imply. The series of decorated stones is broken midway or directly opposite the entrance into the cella by absence of a decorated stone. This space was formerly occupied by a slab bearing one of the most important of all the mural designs of the temple.

On the north banquette of the cella, or on the left of this space,

1. This design closely resembles that on the "Victory Stone" or *chimalli* near Cuernavaca.

the four stones arranged in a series have the designs, Nos. 5–7; on the banquette, at the observer's right hand, there are seven stones with five designs, Nos. 8–12, one of which, No. 6, the median of the three former, repeats a constant symbol among the mural designs.

The first, No. 8, of the five on the right side of the middle of the east wall is duplicated on the north wall by a figure in which the conventional water symbol plays an important part. In the middle of this figure, No. 9, there is represented an object that might be interpreted as a nose ornament of the Pulque god, but the whole figure, unlike that elsewhere mentioned, has no resemblance to a pulque cup or bowl.

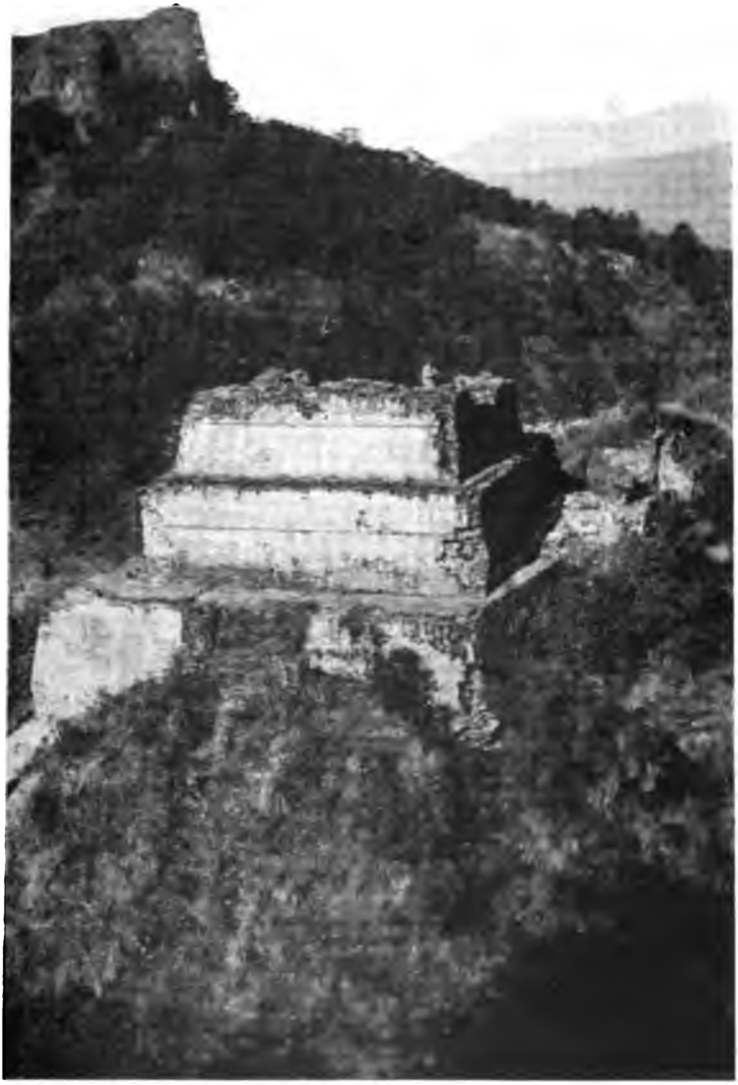
No. 10, the third design in this series, somewhat resembles a hatchet with unknown objects tied to the handle. The following figure, No. 12, is like a wreath with enclosed designs representing water and feathers.

Among the symbols that once decorated the edge of the seat there are nine which are well preserved, but the tenth is somewhat mutilated. Dr. Seler has suggested that the figures on the edge of the banquette represent day signs, but the material at hand is not sufficient to verify or disprove this suggestion. On the row of six stones forming the south side of the cella there are four relief designs.

No. 13, the first figure on the banquette at the left or east end, according to Dr. Seler, represents a skull from which issues blood or water which is represented as flowing over the surface of the second stone. The following figure, No. 14, according to the same author, is the symbol *atl*, water with an eye, *ixtli*, upon its surface. This figure occupies a greater part of the exposed surface of the second and third stones on this side. The signification of the third design, No. 15, is not clear that it is connected in some way with "blood or water" as the accompanying symbols would appear to indicate. The most elaborate design on the walls of the cella is a relief identified by Dr. Seler as a dog (*itzcuitli*) and undoubtedly representing some carnivorous animal. The appendages to the arch are considered by the author above mentioned as feathers of the *quetzal*, concerning which identification he is, however, in some doubt, as he later adds, "das ich wederum nicht sicher zu deuten ware."

In addition to the relief figures on the cella walls, there are similar designs on the vertical stone slabs, and fragments of a seat on the north and south sides of the anteroom, evidently parts of a large series. Four figures, two of which resemble certain reliefs on the cella walls, still remain *in situ* on the north side and on the opposite wall there are likewise two reliefs, one of which is duplicated on the north wall and on the seat of the inner room.

The relief designs of El Casa del Tepozteco above described are among the most instructive relics of serial paleography to be found in place north of Chiapas. These reliefs are now in their original place on the banquette of the Casa del Tepozteco and are represented in the accompanying figures. As shown above, plausible suggestions have been made of the meaning of certain of these designs but many others are not yet identified.



EL CASA DEL TEPOZTECO (East Side)

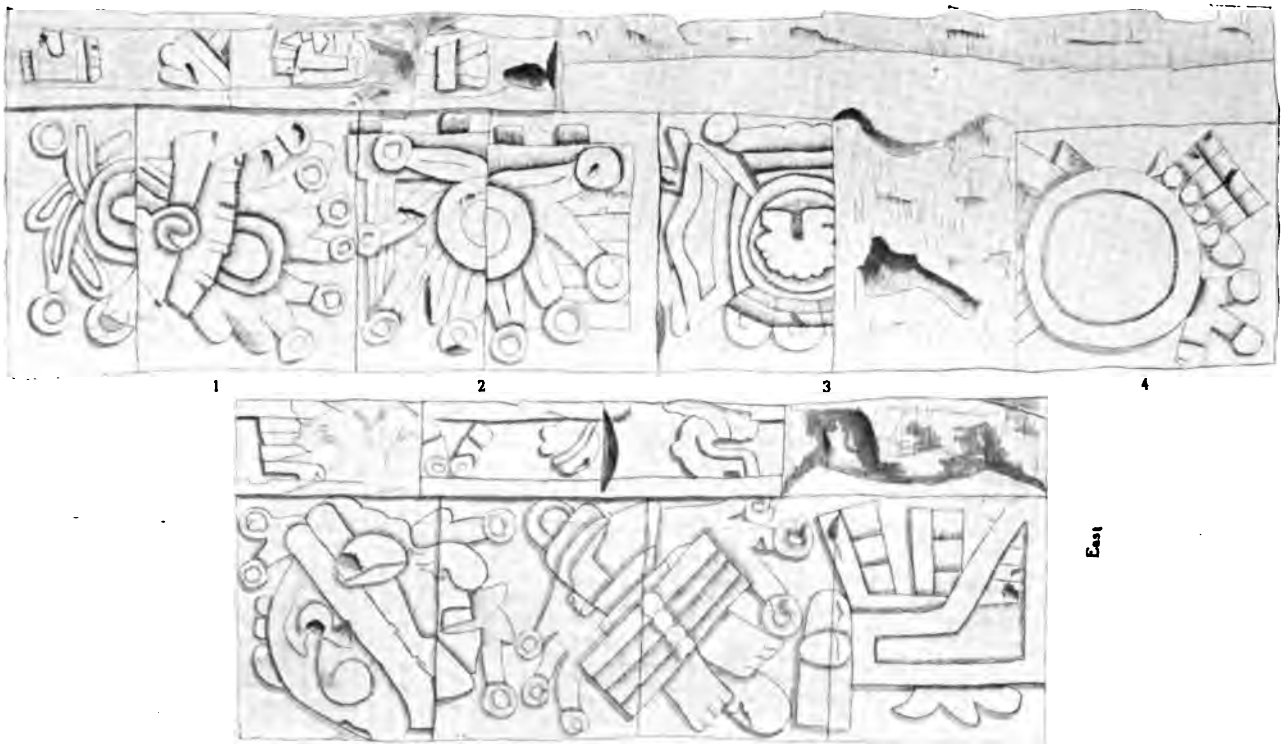
 Photographed by Dr. E. Le Baron

ANTEROOM, EL CASA DEL TEPOZTECO

Photographed by Dr. E. Le Baron

EL GASA DEL TEPOZTECO (Entrance to Cella)

Photographed by Dr. E. Le Baron



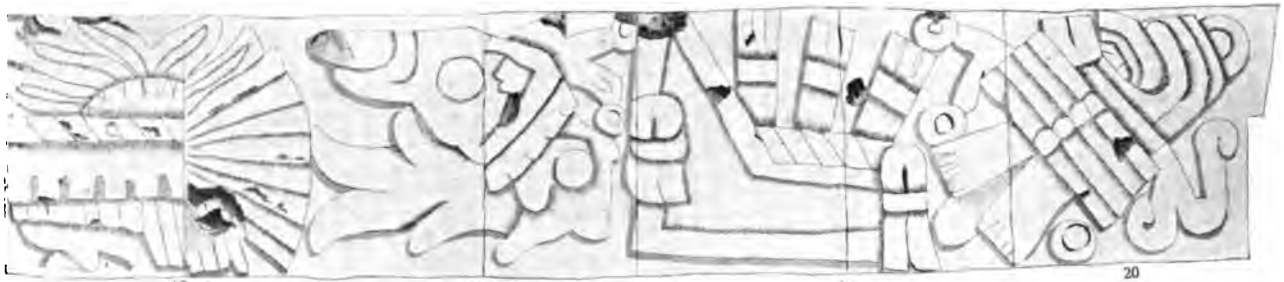
BAS-RELIEFS ON SEAT OF CELLA

B. Verazaluce, ad nat.

BAS-RELIEFS ON SEAT OF CELLA

B. Verazaluce, ad nat.

PLATE VI



BAS-RELIEFS ON SEAT OF ANTEROOM

B. Verazaluce, ad nat.

ON CERTAIN FOSSIL PLANT REMAINS IN THE IOWA HERBARIUM

BY THOMAS H. MACBRIDE

The herbarium of the State University of Iowa contains a not inconsiderable amount of paleobotanical material, the gradual accumulation of many years. Of these accumulations the greater part consists of thousands of leaf-prints from various beds, both in the state and outside its boundaries; but certain plant-stems and fragments of the woody parts of ancient plants form also a no less valuable part of the collection, and to some of these, perhaps, present attention may for a little with profit be directed.

In the investigation of fossil stems the student is confronted at once by certain obvious disadvantages. In the first place his material is always more or less fragmentary. He has, in the main, only microscopic structure as a basis of identification. This is the more unfortunate since in the study of the existent types all sorts of characters prove more convenient than these to which we are here largely, sometimes entirely, limited. In the present problems ordinary experience, therefore, brings us less assistance.

The determination of specific difference by considering microscopic structure of the stem alone would be difficult enough did we compare the forms that stand about us; how much is that difficulty increased when we attempt to compare with existing types structures that belong to a different geologic age!

In the second place, the material to be studied is often but imperfectly preserved. Silicification is sometimes attended by secondary crystallization or has been in various ways disturbed so that the structure is obscured, and tantalizes the student by suggesting that which cannot be exactly ascertained. This is true also even of material fossil, but not silicified. Wood from pleistocene deposits is not infrequently obscure in microscopic structure although, at first sight, well preserved.

Under these circumstances the study of such material would seem to offer little encouragement indeed; and yet it has seemed better to accumulate and record some of the facts we have, in the expectation that these may at length, in some future day, become a part, however small, of a body of knowledge sufficient for more exact inference and conclusion, and so help men in that day better to understand and realize the orderly succession of the flora of the world.

Our fossil stem-fragments fall naturally into two divisions according as they represent paleozoic or pleistocenic material, and we may conveniently present them in this order. As is well known, the coal-bearing strata everywhere offer abundant casts which have been sufficiently described as *Lepidodendron*, *Sigillaria*, *Stigmaria*, etc., and our collections are not destitute of these things; but these will not be here considered. We consider in this discussion only such of our fragments as lend themselves to sectioning or in such way reveal the original microscopic structure, and only such of these again as show a reasonably secure identification. The paleozoic stems studied are all silicified: the pleistocene material is only slightly changed; would be termed half-rotten wood.

PALEOZOIC STEMS.

PTERIDOPHYTA.

Our pteridophytic material consists first of several fragments of beautifully preserved Sigillaria stems. These are only fairly well shown in the accompanying illustrations. No illustration can give exact idea of the clean beauty of the preserved material. Fresh material was in some ways never finer. For the sake of reference we have ventured to give the material in hand a name, with the distinct understanding that specific characters are in the case largely a matter of assumption.

Sigillaria calvini Macbr., n. s. Plates I, II, III, IV.

The specimens upon which, for sake of reference, this species is founded are three. They belong, as will appear, possibly to two or three different plants, but show in so far identical structure.

A. The fossil described is fourteen centimeters long and about

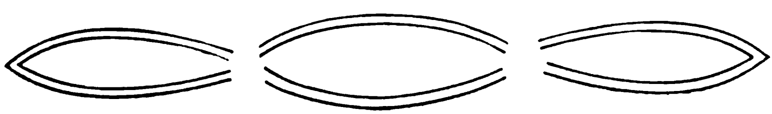
five thick and represents almost throughout the characteristic scalariform woody tissue described below in detail. The specimen has been subject to some compression and in fact represents perhaps no more than one-half the original trunk, as in cross-section the wedges that make up the wood-cylinder have a length of three and one-half centimeters. From the curvature of the circle bounding a section of the stem we estimate the original diameter of the woody cylinder as ten centimeters, which would leave for the pith a diameter of four centimeters. This pith seems to have disappeared completely before silicification.

The cortex in the present specimen is also almost entirely lacking. If we may judge from traces present, the entire cortex seems to have been converted into coal.

B. The second specimen so exactly resembles the first in general detail that it may be assumed part of the selfsame trunk. It comes from the same place and was furnished by the same collector. This specimen measures about ten centimeters in length and about five centimeters in greatest width. Of this width about one and one-half centimeters represents the persistent remnant of the inner cortex. Plate I, Fig. 1. The woody part of this stem has been perfectly silicified, but has been subject to no compression, no distortion, and the entire structure is perfect.

C. The third specimen of the set, about twenty-five centimeters in length, is a portion of a stem entirely flattened by pressure applied previous to silicification. The woody cylinder, stele, was comparatively thin, seven or eight mm. in thickness, but the total diameter of the stem apart from cortex must have been several centimeters, as will appear from the description following:

The outer cortex seems to have, as usual, passed into coal. Very little of the inner cortex remains; perhaps only a trace obscurely fluted as in Sigillaria, and with traces here and there of the ordinary leaf-scar, the central pit usually discoverable. In flattening, the medulla seems to have disappeared altogether and the stele or hollow cylinder of this woody tissue collapsed by breaking into a succession of small arcs which are conjoined by



their ends. At least three of these arc-sets resulted from the breaking down of the cylinder under a uniform lateral pressure. In the process of flattening the cylinder, under a tangential cleavage, separated as upon a line of growth, in such fashion that the older wood parted easily from the younger, leaving these parts to form singular flattened, delicately fluted columns, of which the sections are shown in the accompanying diagram. See also Plate I, Fig. 2, and Plate II, Fig. 1.

The primary or younger wood which forms the walls of these columns is made up of scalariform ducts of unusual width, .010–.014 mm. in diameter. These are of varying length and marked by slender, distant, transverse thickenings which must have lent to the structure entire, lightness with considerable strength. The secondary wood is composed of similar ducts about one-half as great in thickness and increasing in diameter towards the periphery; but the secondary wood is everywhere shot through by cell-masses representing medullary rays and in this particular differs in marked manner from the inner or primary structures.

In all three specimens the general structure is essentially the same; in each the secondary wood is prominent, distinguishable by its smaller cells; but in B the primary wood is wholly lacking. Medullary rays, as stated, characterize the secondary wood only. Plate II, Fig. 2, and Plate III, Figs. 1 and 2. These are very imperfectly developed, uneven and irregular; sometimes consisting of a single row of transverse cells only, sometimes of many, forming, in section, a figure several cells high and two or three cells thick. We have not been able to trace the continuity of the medullary system with leaf structures in the cortex, as is to be expected. This, partly because it is not deemed advisable to attempt further mutilation of our material. The cortex, where still in place, was evidently largely decomposed prior to silicification. Most of the structure has been replaced by mineral deposits in which only crystalline organization is evident. Occasionally, however, remnants of the same curious tracheary tissue appear which has been above described. These remnants doubtless represent the woody strands of foliar organs. Plate IV, Fig. 1. The medullary cells also show scalariform markings and seem not dissimilar to the prosenchymatous elements.

The relation between primary and secondary wood is made clear

in several sections. Plate IV, Fig. 2. On the outer side of the primary stele merismatic cells developed. These gave rise outwardly to the secondary wood much as cambium in the modern exogen gives rise to phloem. The difference between the ancient structure and the modern appears, however, in that in old Sigillaria growth seems to have proceeded by differentiation of the outer meristem only. Also, this differentiation was apparently slow; the cells set off were like the trachea of the primary wood but of small diameter, and surprising as it may seem, capable of slowly growing in size as they were pushed farther and farther out from the stem center. As stated, in the secondary wood the cells of greatest diameter are peripheral, but on the outer face of these there is no indication whatever of a second meristem. The woody tissue was probably pushed out into a parenchymatous cortical mass similar to that which made up the medulla, and which must have given way in every direction before the energy of endogenous structures whether of stele or leaf-stems. These apparently followed for some distance the course of the primal axis.

It may be further remarked, as is evident in our plate, Plate IV, Fig. 2, that the line of separation between the two phases of woody growth in the stem is not a simple curve such as is met, usually, in modern stems, but is strangely sinuate. This gives to the inner stele, where freshly exposed, a peculiar fluted appearance otherwise difficult to understand. See also Plate I, Fig. 2. It would seem as if the merismatic cells themselves arose not as a continuous sheath, but rather as strands which presently become laterally continuous.

This peculiar stem is referred to the genus *Sigillaria* because of the leaf-scars on the surface of the ribbed stem, and because of the microscopic structure above detailed. As to specific identity it may be compared with *S. menardi* Brogn., from which the different structure of the primary wood-cylinder easily separates it. The same peculiarities of structure seem to separate the Iowa material from *S. spinulosa* Germ. In our Iowa specimens the primary cylinder is well developed, of large tracheides without rays or any indication of individual bundles. The merismatic tissue which appears on its outer surface shows, by no indications now legible, any relationship to the older or primary structure.

All specimens referred to *S. calvini* are from the Des Moines

stage of the Upper Carboniferous, as exposed near Panora, Guthrie county, Iowa. The specific name is in honor of Professor Calvin of the University, through whose courtesy the material came to my hand.

Psaronius borealis Macbr., n. s. Plates V, VI.

The fossil here described is represented by several fragments of a pteridophytous stem about ten centimeters in length and six in width. The whole specimen is strongly impregnated with iron, probably hæmatite. The iron deposits are so extensive as to have replaced almost entirely the vascular parts of the associated structures. The central mass of the stem seems to have been composed of two elements, a parenchymatous, as we infer from the homologies of the case, now wholly lost and replaced by sand, and a vascular element preserved only in part, but showing the band-like form characteristic of the stems of larger ferns, as, for instance, some Cyatheas, where the section of each bundle is arcuate with the tips of the arc more or less reversed or flexed. This feature of the fossil is indicated in Plate V, Fig. 1. The entire stem, when perfect, must have been fifteen or eighteen centimeters in diameter.

The outer part of the stem, Plate V, Fig. 2, much better preserved than the central axis, shows a vast multitude of vascular strands more or less parallel to each other and to the principal axis; not straight, however, but interwoven, grown through each other apparently in a most intricate mass. Between the strands a crude, rather thick-walled parenchyma is seen. Each strand has for its center a fibro-vascular bundle of the concentric type, showing scalariform ducts of unequal diameter; but the bundle is itself surrounded by a strongly developed sheath or mass of sclerenchymatous cells everywhere well preserved. Plate VI, Figs. 1 and 2.

The generic reference of this fossil would seem sufficiently clear. Specific distinctions here, as elsewhere, are purely tentative, but for convenience of reference the specimen may be called by a specific name. The distribution of the principal vascular strands may possibly here suggest specific characters, although in existing forms such arrangement is generally significant of a much larger group.

Our material is from Hardin county, Iowa, and represents, apparently, the Des Moines stage of the upper Carboniferous.

SPERMATOPHYTA.

GYMNOSPERMÆ.

CONIFERALES.

The collections of the University contain a very considerable number of fossil stem-fragments referable to coniferal species. These are from one or other of two horizons, from the carboniferous and from the pleistocene. They are from various localities and, as noted, of wide-sundered geologic age. Only those collected in Iowa are presented at this time.

Araucarioxylon occidentale Macbr., n. s. Plates VII, VIII.

Our first species is represented by certain large stump-like masses of petrified wood from Van Buren county. Plate VII, Fig. 1. These great masses, from forty to fifty centimeters in either diameter, show at sight their origin and are instantly recognized as petrified wood. The specimens occur detached and free upon banks and bottoms of watercourses and have been, evidently, long exposed to weathering. As a result the silicified layers of wood are liable to separate from each other, and nowhere yield the clearest sort of microscopic sections. Nevertheless, as shown by Plates VII–VIII, legible structures have been obtained. We have to do with a conifer, apparently, with large pith; with distinct lines of growth; without resin ducts, or at least with few; with bordered pits in single or double series upon the radial faces of the elongate cells or tracheides (Plate VII, Fig. 2), the pits closely placed but not mutually interfering. For these reasons we refer the material to the genus *Araucarioxylon* Kraus. The small bordered pits in single or double rows, with apparently elongate openings, suggest the structure of no ordinary conifer and emphasize the uncertainty of all our reference in absence of facts other than those largely by the microscope revealed.

The fossils before us, then, show the usual tracheides quadratic in transverse section with an average diameter of 22μ. These are furnished on the radial sides with small bordered pits, more often

in single rows, along the middle of the face, sometimes in double rows, closely placed but not compressed, in diameter about one-fourth the width of cell. The pit or opening is, as stated, slit-like or oval and the two openings on opposite sides of the tracheide wall appear to have been transverse to each other. An occasional pit appears on the tangential face of the cell. In transverse section the pits show the usual figure as seen in recent forms.

On sections of the material uncertain lines of growth appear, or at least the rock tends to split in concentric fashion. The concentric plates are remarkable for their thickness, being from seven to eight $^{mm.}$ broad. Under the microscope the line of growth is not always distinguishable, owing to the irregularity of the silicification. Some sections, however, are sufficiently clear, Plate VIII, Fig. 1; the autumn-wood shows some modification, but less pronounced thickening. Possibly the difference shown in the fossil corresponds to the chemical rather than the physical condition of the wood replaced. There is no apparent reduction in the radial diameter of the tracheides nearest the line of growth-boundary, as is commonly the case in our recent woods.

The medullary rays are composed of simple parenchyma cells, quadrate, rather long, extending across four to seven tracheides or more, showing in the sections at hand no pits or openings of any kind. Seen in tangential section the medullary rays appear as simple vertical cell-rows, Plate VIII, Fig. 2, occasionally, but rarely, two cells in width, but in such cases only for a short distance. The number in a section is variable, from six to twenty. No resin ducts have been discovered in any of the many sections studied, and we presume their absence.

Our material is from weathered slopes representing the exposures of the Des Moines stage of the Upper Carboniferous, Van Buren county, Iowa.

In connection with those palæozoic stems it is proper to place upon record one other fragment interesting for what it records rather than for its own identity. In Plate IX, Figs. 1–2, we show views of a bit of drift from the Wisconsin or most recent glacial deposits of Northwest Iowa. Its history is inferable only from what we learn from other sources. Here we have a piece of exogenous material, a piece of an exogenous trunk perforated in

almost every part by the borings of some old-time Teredo. The specimen is so cut to pieces by the borings, now filled up, of course, that a fair section of the wood is with difficulty obtained. From the fact that Cretaceous rocks lie in the pathway of the ice-sheet that brought us the drift, and the further fact that the upper Cretaceous deposits are everywhere full of dicotyledonous fossils, we are led to the conclusion that our fossil is probably of the age named. Teredines are found fossil in the Old World from the Jurassic up.

In our fossil the laminated substance of the shell is shown in several sections.

PLEISTOCENE STEMS.

CONIFERALES.

Picea mariana (Miller) Britt. Plate X.

In our collection are a great number of specimens of wood from the forest bed found in Iowa everywhere, usually immediately beneath the blue clay. These wood-fragments are generally well preserved, so much so that microscopic sections are easily made and microscopic structures easily observed. Such examination, so far, has brought to light coniferous wood, and coniferous wood only. In the absence of foliage and fruit our determination of even these almost modern materials is attended with some uncertainty. Some of the fragments have been referred to *Larix larcina*, others to *Picea mariana*, *P. nigra* auctor., the common black spruce of our northern coniferous forest.

Our present specimens are cones about one inch in length and about one-third of an inch in diameter; one with the scales slightly expanded, the other closed as prior to seed-dispersal. Whether the latter contain seed has not been determined,—cannot be without destroying the fossil. Accompanying the cones were found bits of wood. These, however, represent the following named species.

Our illustration, Plate X, Fig. 1, shows the cones above mentioned about twice natural size, from beneath the Kansan drift, in Washington county, Iowa.

Picea canadensis B. S. & P. Plates X, XI.

The fine block of fossil wood shown in our Plate X, Fig. 2, is from the base of the blue clay near What Cheer, Keokuk county.

The wood has fairly well resisted decay, is strongly impregnated with ferrous sulphide, in some parts carbonized so that it breaks with smooth black fracture and resembles lignite. In other parts the tracheides, especially in the neighborhood of the spring wood, show evidence of crushing and the structure is largely obscured. But in some places the cell-walls are almost perfect and sections are entirely satisfactory.

The specimen represents a stem which must have been originally twenty or thirty centimeters in thickness. At present the fragment is twenty-five centimeters long, about eight centimeters in the shorter, about twelve centimeters in one-half of the longer diameter; the block in this direction is imperfect and incomplete.

The identification here proposed is based wholly upon the microscopic structure of the wood. In Plate XI, Figs. 1 and 2, this is shown in the upper figure contrasted or compared with the figure of a corresponding section made from the fresh wood of the species as now grown by cultivation in Iowa. The correspondence of structure is, it is thought, remarkable. The microscopic sections suggest an identity even more exact than the illustration shows. The peculiar oblique or spiral striæ which mark the wall of the tracheide and which leave their trace upon our plate illustrating the fossil, are distinguishable in microscopic sections of recent wood, but do not come out very plainly in our photographic print. It must be noted too that these spiral markings appear equally distinct on the tracheides of *Picea abies* (L.) Karsten, as we have learned by comparison of material grown in Iowa. In fact the two species of modern spruce named may, by the microscope, only with difficulty be distinguished. We have referred the fossil to the one species rather than the other simply because *P. canadensis* is still a habitant of North American forests, while *P. abies* is not, and if it ever was, which is certainly by no means improbable, it is hard to see why the approach and recession of the ice-sheets should have brought it to total extinction. Our reference to the existent species is more plausible, even although the microscopic evidence inclines rather to the European form. Plate XII, Figs. 1 and 2, shows further the microscopic structure of this fossil spruce, in sections transverse and radial.

EXPLANATION OF PLATE I.

Figure 1.—Radial view of specimen *B* of *Sigillaria calvini*. The remains of the cortex appear above and the medullary cleavage of the wood appears clearly shown.

Figure 2.—Tangential view of specimen *C*, *Sigillaria calvini*. A small fragment of cortical structure appears at the upper left hand corner of the figure; in the middle we have the natural (?) outer surface of the wood-cylinder, showing obscure *Sigillaria* imprints; next the inner surface of an arc of secondary wood, and at the bottom the outer surface of a similar corresponding arc of primary wood. Note that the fluted or channeled appearance is due to the crenulate or wavy line of separation between the primary and secondary wood. See Plate V, Fig. 2.

Fig. 1

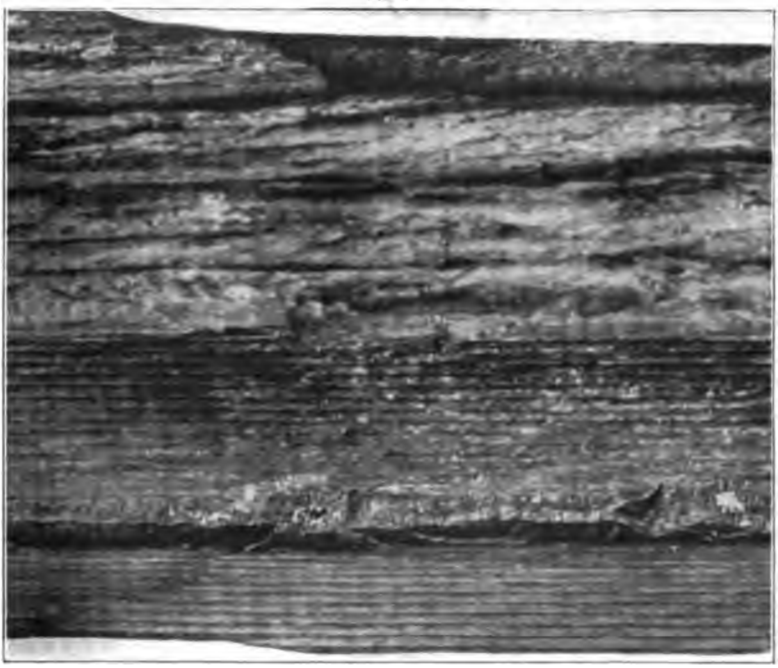


Fig 2

EXPLANATION OF PLATE II.

Figure 1.—A transverse section of one portion of the compressed wood cylinder, primary wood only, *Sigillaria calvini*, magnified about 30 diameters. The pith has been entirely supplanted by silicious deposits. The crushed cells are to be noted at the extreme left of the figure.

Figure 2.—A transverse section of secondary wood of the same species, x 100. The medullary rays are here conspicuous.

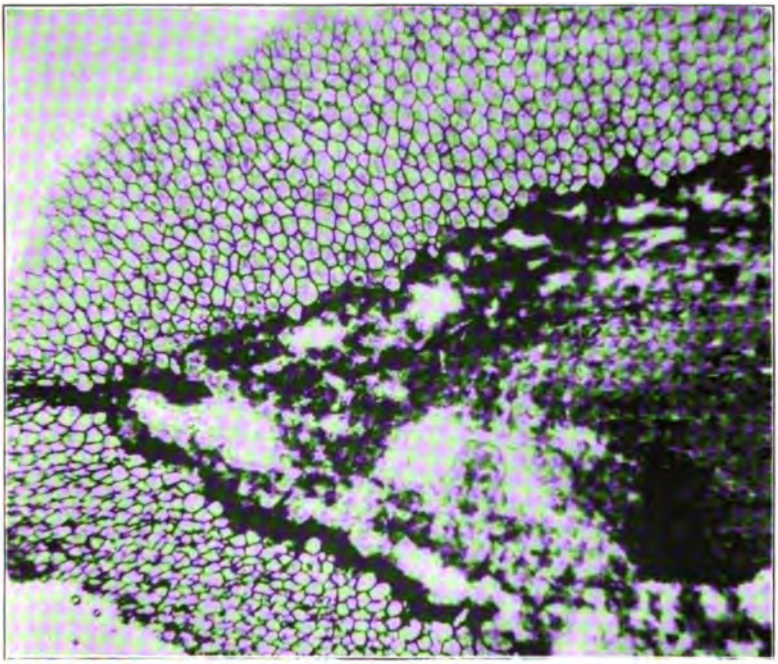


Fig. 1

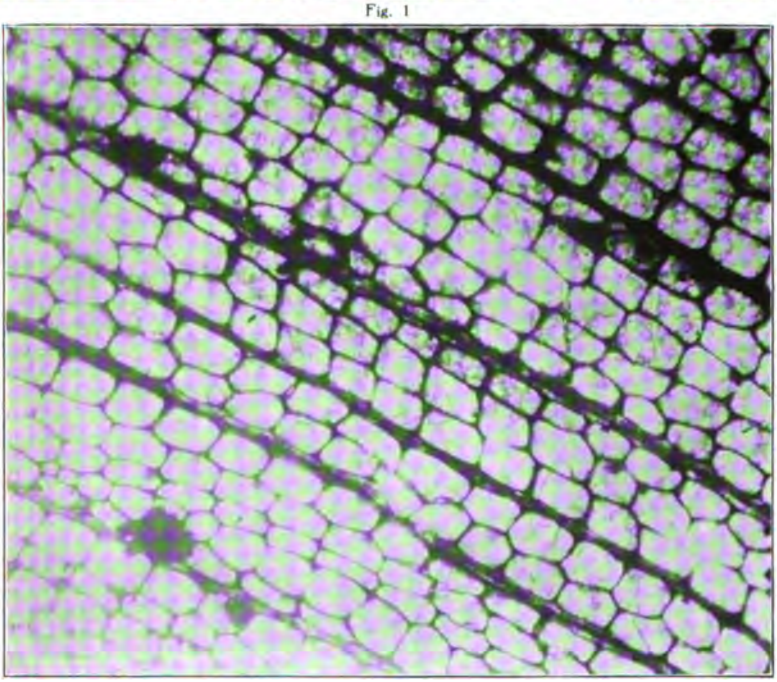


Fig. 2

EXPLANATION OF PLATE III.

Figure 1.—Radial section of *Sigillaria calvini*. The figure is made to show the comparative breadth of the medullary rays.

Figure 2.—Tangential section of wood of the same species to show the irregularity and imperfections of the whole medullary system.

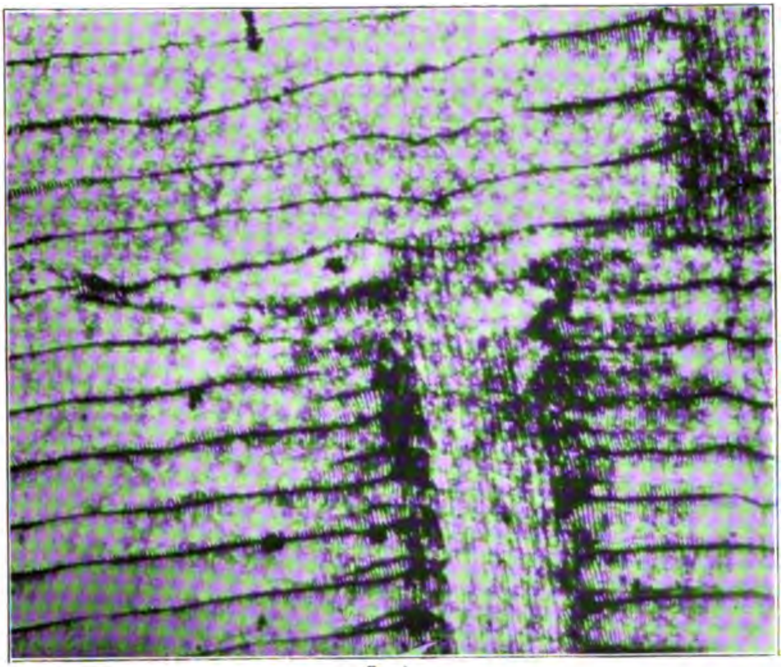


Fig. 1

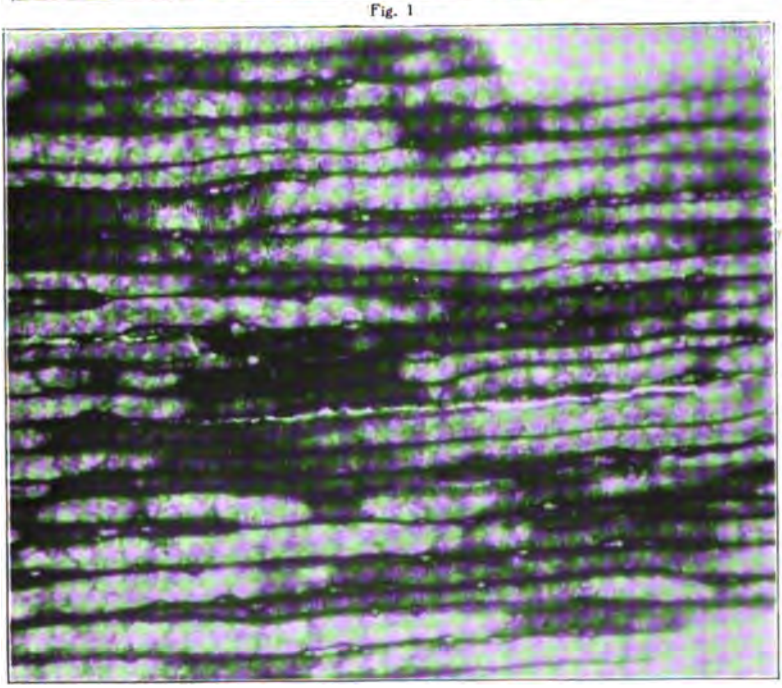


Fig. 2

EXPLANATION OF PLATE IV.

Figure 1.—Transverse section of the fragment of *Sigillaria calvini* shown in Plate I, Figure 1. The section was made in an attempt to show the cortex structure. A piece of the secondary wood has slipped in the preparation so as to obscure the structure in part. In the upper part of the figure the contact of wood and cortex is shown.

Figure 2.—Transverse section of the fragment of the same material shown on Plate I, Figure 2. Here the primary and secondary wood rings appear in more or less exact contact, showing apparently the merismatic cells from which the secondary tracheides are developed.

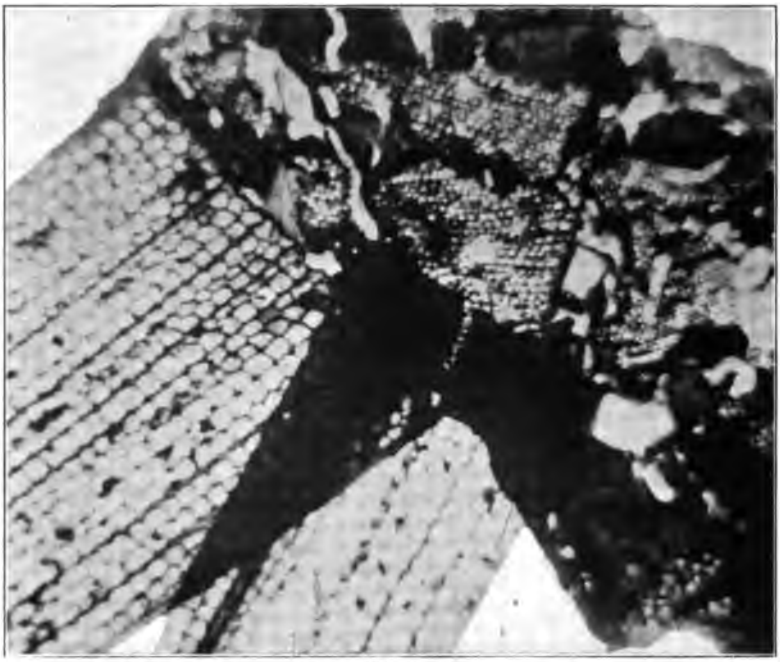


Fig. 1

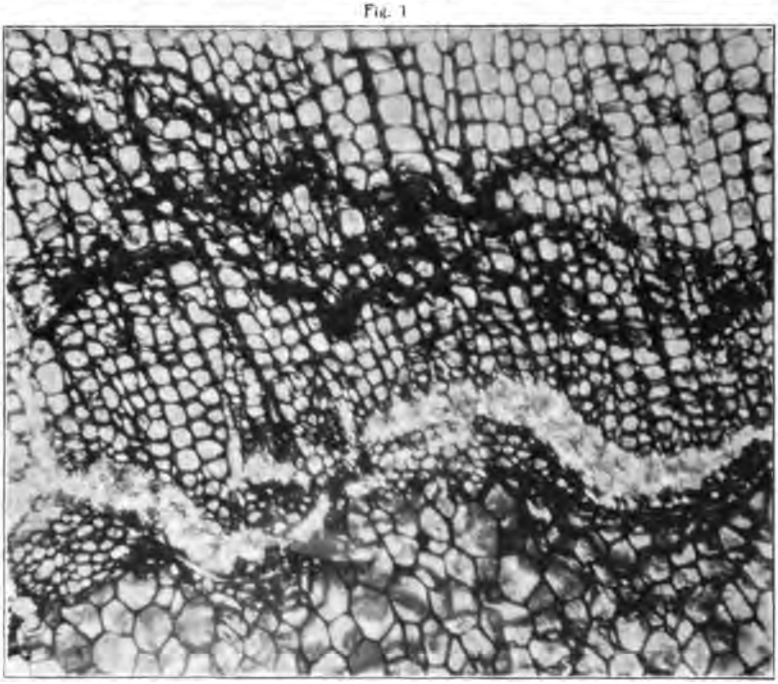


Fig. 2

EXPLANATION OF PLATE V.

Figure 1.—End-view of a fragment of *Psaronius borealis*. To the left are shown the peculiar vascular bands, arcuate and involved; to the right the peculiar cortex characteristic of the genus.

Figure 2.—Tangential view of the same specimen. The peculiar vascular thread-like descending roots are fairly shown.

Fig. 1

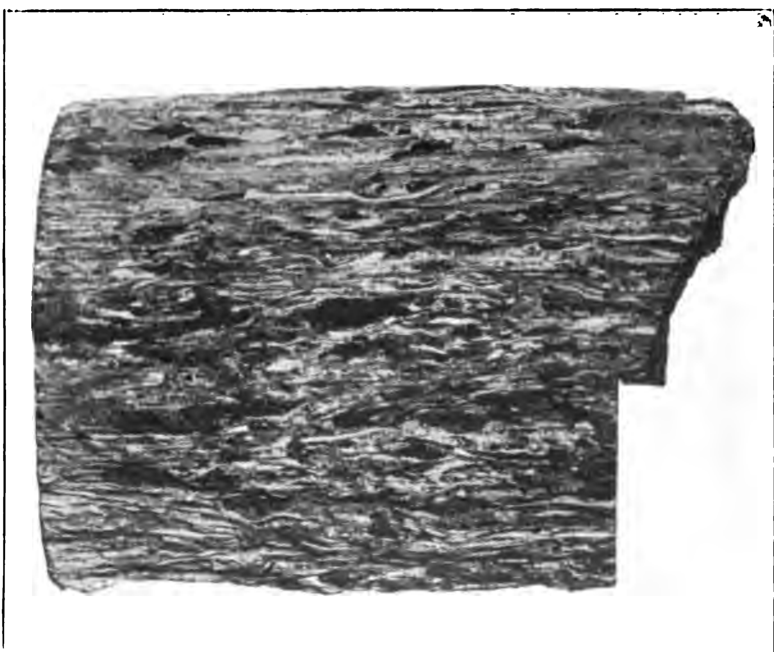


Fig. 2

EXPLANATION OF PLATE VI.

Figure 1.—A transverse section of a fragment of *Psaronius borealis*. The section shows, at the lower left hand corner, tracheæ in the center of the bundle.

Figure 2.—A similar section of the same fragment to illustrate the general structure. Five bundles are shown nearly entire; between these, extending transversely across the figure, is the ordinary modified parenchyma, forming here the fundamental tissue of the stem. The sclerenchymatous bundle sheaths are well shown, much as in the case of the bundle of a modern endogen.

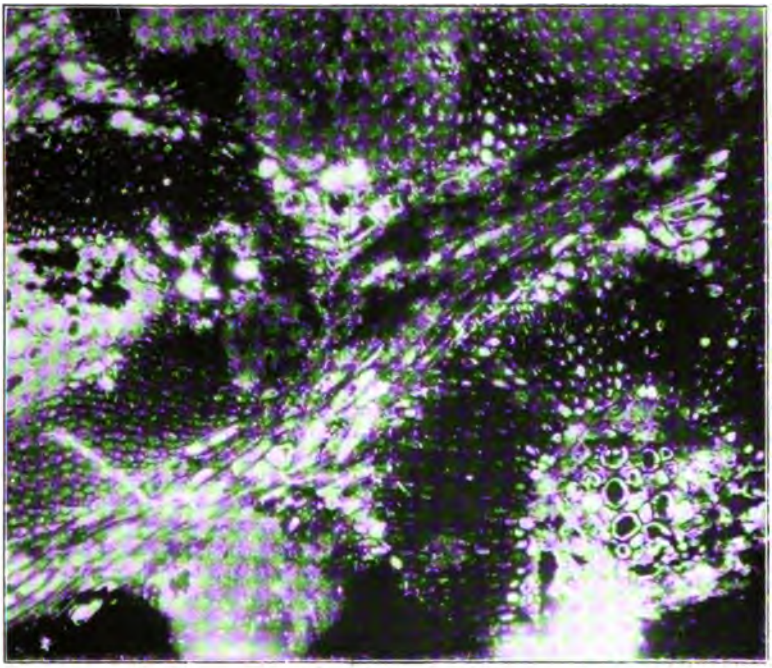


Fig. 1

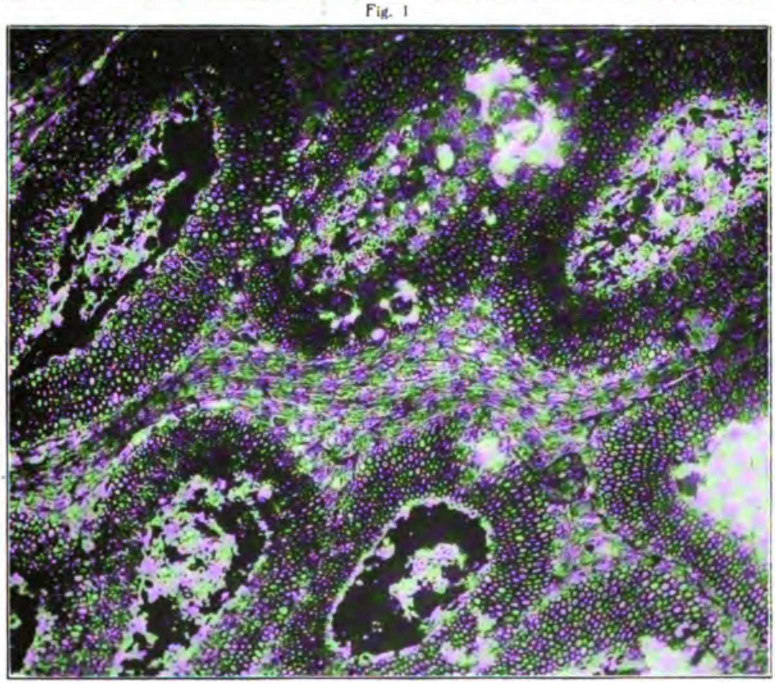


Fig. 2

EXPLANATION OF PLATE VII.

Figure 1.—Stump of *Araucarioxylon occidentale*, x $\frac{1}{10}$.

Figure 2—Longitudinal, radial section of the silicified wood of the species figured above. Medullary rays appear at the left.

Fig. 1

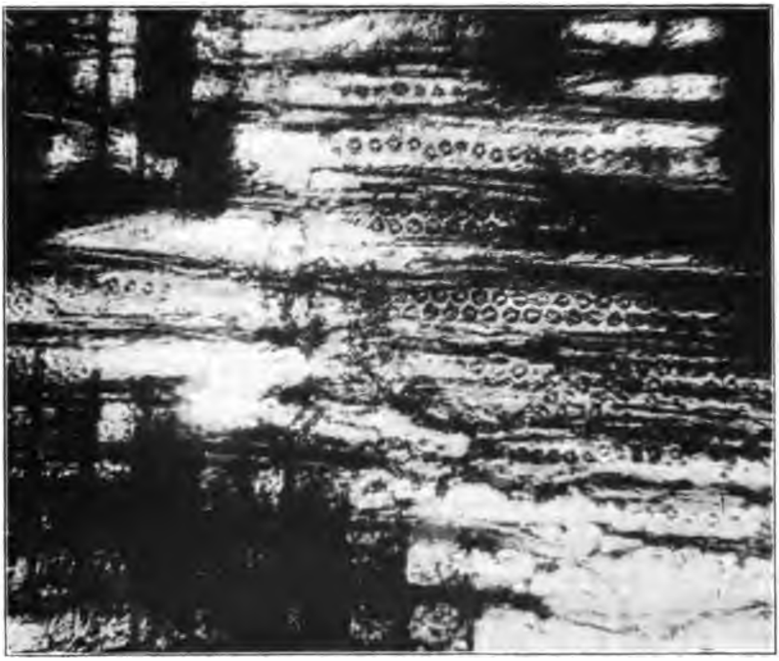


Fig. 2

EXPLANATION OF PLATE VIII.

Figure 1.—Transverse section of *Araucarioxylon occidentale*. The section shows a line of growth (so assumed) extending vertically almost in the middle of the plate.

Figure 2.—Tangential section of the same material to show the distribution and height (measured in superimposed cells) of the medullary rays.

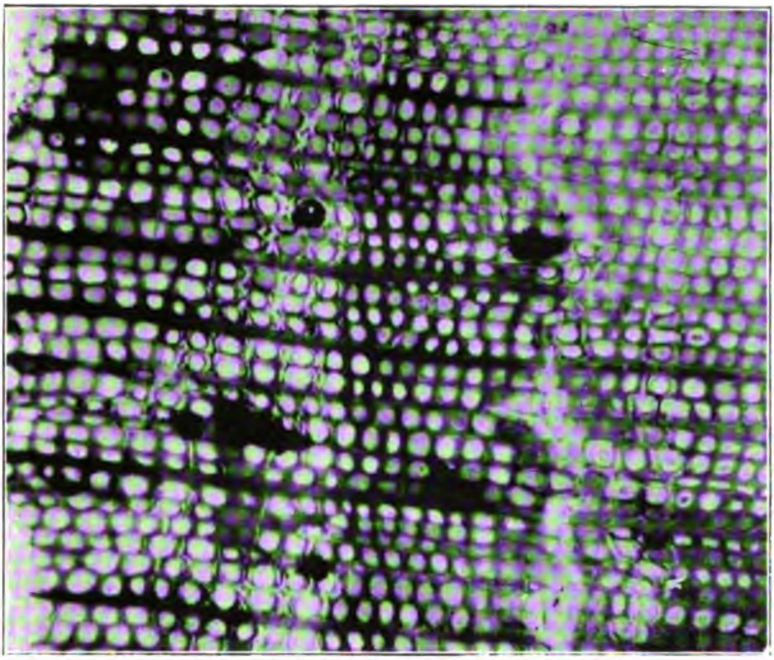


Fig. 1

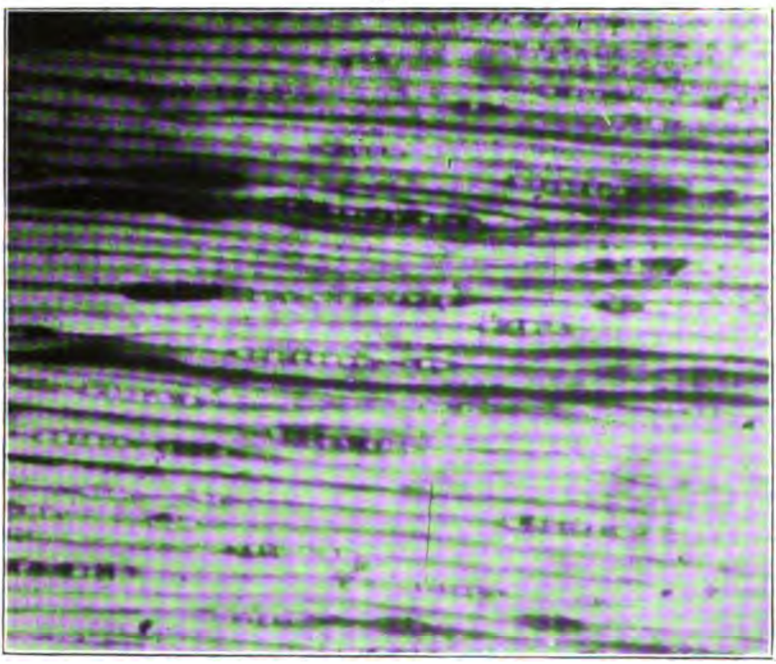


Fig. 2

EXPLANATION OF PLATE IX.

Figure 1.—Silicified block of some deciduous tree, almost entirely consumed by teredos prior to silicification. About one-half natural size.

Figure 2.—Fragment of the same block showing the toredo burrows in cross-section.

Fig. 1

Fig. 2

EXPLANATION OF PLATE X.

Figure 1.—Two cones of *Picea mariana* from below the blue clay. The figures are shown about twice the natural size.

Figure 2.—A fragment of wood from beneath the blue clay. The fragment is referred to *Picea canadensis*. The figure is about one-half natural size.

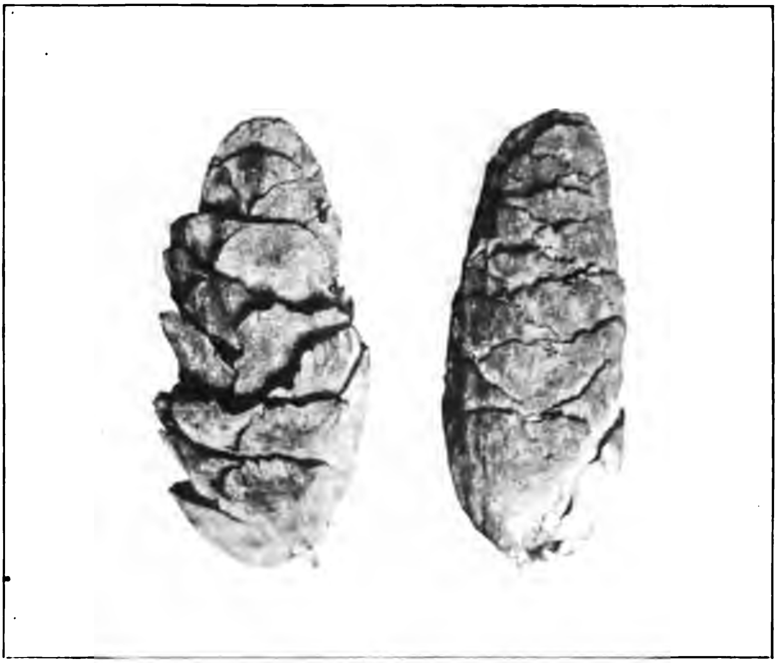


Fig. 1

Fig. 2

EXPLANATION OF PLATE XI.

Figure 1.—Tangential section of the wood of the fragment shown on Plate X, Figure 2. The section of a resin passage occupies the center, and the striæ of the tracheides come out well in all parts of the section.

Figure 2.—A correspondnig section of recent wood, *Picea canadensis*, introduced for comparison. The striæ on the tracheides are less distinctly shown in the fresh unstained wood as here.

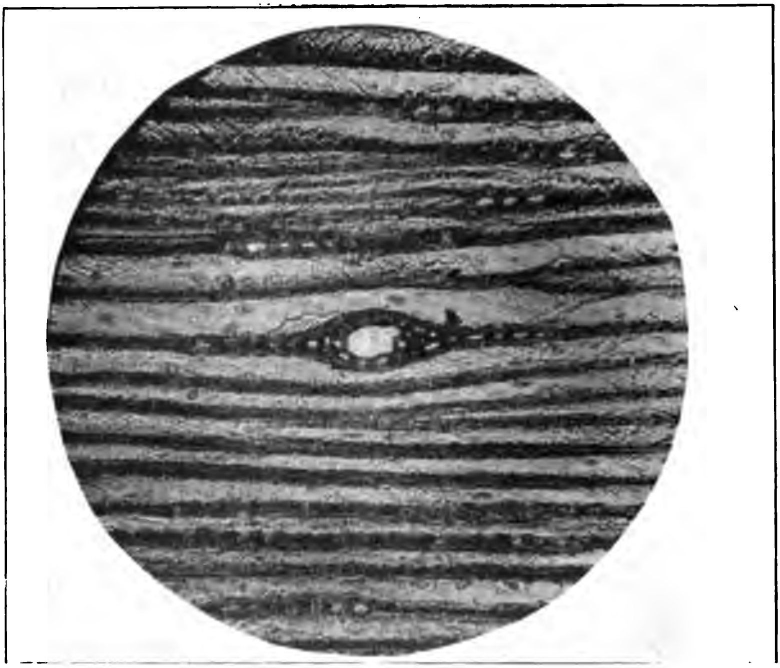


Fig. 1

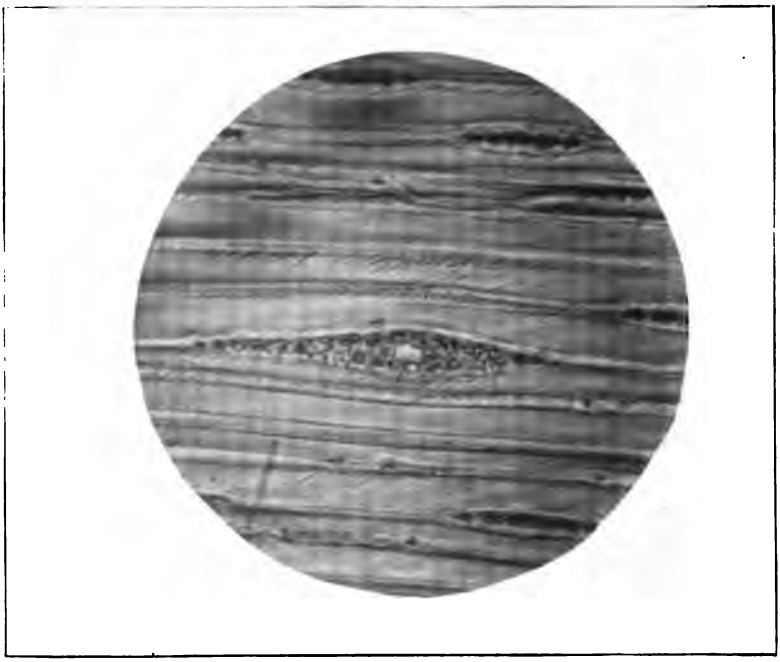


Fig. 2

EXPLANATION OF PLATE XII.

Figure 1.—Transverse section of *Picea canadensis* from the so-called "forest-bed" beneath the blue clay. The section shows three resin-ducts.

Figure 2.—Radial section of the same material cut so as to show the bordered pits.

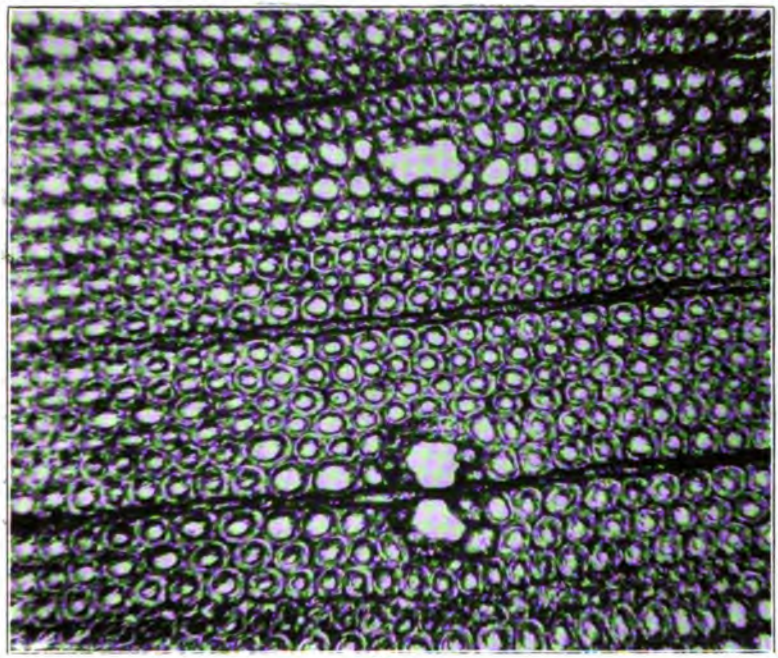


Fig. 1

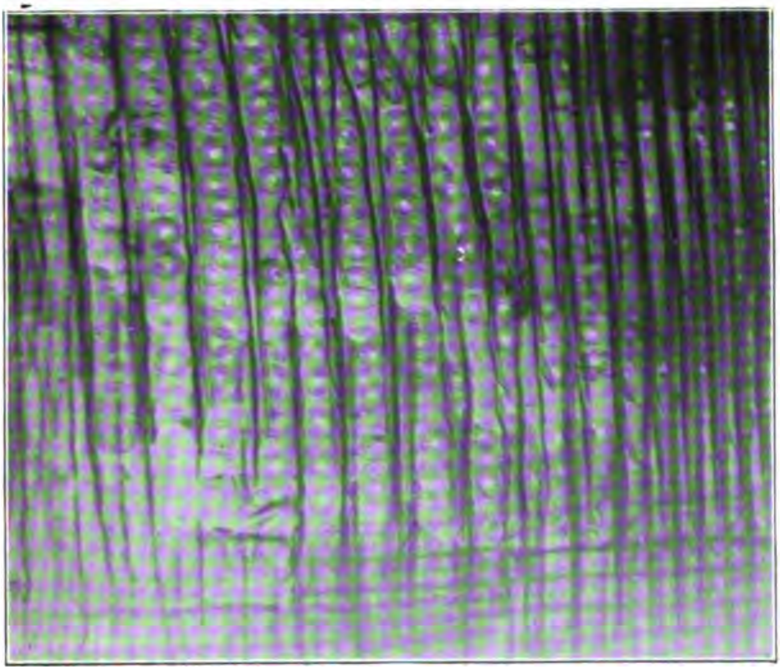


Fig. 2

DESCRIPTIONS OF NEW FORMS OF JASSIDAE

HERBERT OSBORN

DORYCEPHALUS PUTNAMI n. sp.

Black, head produced but shorter than other species of the genus, longer than width between the eyes, margins very thin, elytra long, extending almost to tip of pygofer; length, male, 5^{mm}.

Head much less produced than in *platyrhynchus*, narrowed to a rather broadly rounded apex, margin thin, foliaceous, slightly upturned, becoming somewhat spoon-shaped at apex; the surface of the vertex rather distinctly marked with longitudinal rugosities. Eyes elongate, extending about half their length on margin of pro-thorax, ocelli on margin between vertex and front and close to the compound eyes; front somewhat tumid, becoming carinate where it merges into the vertex, flattened at base of clypeus; the sutures converging sharply from antennal sockets; loræ widening apically, nearly reaching margin of the cheek; clypeus with parallel sides, apex reflexed and very slightly expanded. Pro-thorax shorter than vertex, wider than long, with a distinct median carina reaching nearly to the hind border; the surface strongly punctate and, posteriorly, with transverse rugæ; scutellum punctate, faintly rugose. Central transverse impression distinct and two fainter longitudinal impressions. Elytra scarcely reaching tip of abdomen, opaque, faintly and minutely punctate, inner claval vein joining the outer near its tip.

Color.—Black throughout.

Genitalia.—Male valve short with an obtuse angle behind; plates as wide as valve at the base, the outer margins sinuate, the apices acute, reaching about two-thirds the length of the pygofer. Pygofer conical, opening posteriorly, obliquely truncate.

Described from two specimens, males, one from Chester, Ga., from the Georgia State Collection through the kindness of Mr. Wilmon Newell; the other from Jacksonville, Fla., collected by

Mrs. Annie Trumbull Slosson and kindly loaned to me by Prof. E. D. Ball. This is an interesting addition to this genus, differing in shorter head and black color from our previously known species and occupying a new range; hitherto no species has been recognized in our southeastern fauna. I take pleasure in naming it in honor of Mrs. Mary L. D. Putnam who, during her lifetime, did so much for the encouragement of science, especially in Entomology.

DELTOCEPHALUS SANDERSI n. sp.

Gray with black points on apex of vertex, disc of clavus and corium and black border to reflexed costal veins. Face dusky, gradually paling below. Length, female, $3.55^{mm.}$, male, $3^{mm.}$.

Head acutely produced, rounded at extreme apex, vertex about one and one-half times as long as broad, flattened front broad and prominent. Clypeus narrowing to truncate apex, loræ rather small, borders of cheeks nearly straight. Pronotum distinctly truncate behind, lateral margins extremely short, forward costal veins sharply reflexed.

Color.—Ashy gray, a quadrate spot including a white dot on apex of vertex, an oblique spot on clavus and at base of discal cell, hinder edge of reflexed veins and border of central apical cell black, face dusky above with five or six light arcs becoming paler on lower portion; beneath and legs uniformly gray with black points at tip of hind tibiæ, bases of tibial spines and a band on the hind tarsi blackish.

Genitalia.—Female ventral segment short with a central produced rounded lobe with a black border; pygofer, short, thick, dusky with whitish points from which arise short, stiff, blackish hairs. Male valve triangular, posterior border slightly acuminate, plates broad at base, narrowing sharply, produced apically, slightly divergent, acute at tip, scarcely twice as long as valve, about two-thirds as long as pygofer.

Two specimens, one male and one female, from Ch. Bridge, Va., collected by Mr. J. G. Sanders, and two specimens, one male and one female, the latter with upper half of face darker than other specimens, collected at Monticello, Ga., by E. S. G. Titus. This species resembles *flexuosus* Ball in general appearance but differs decidedly in genitalia of both male and female. I take the liberty

to name it in honor of my friend and former student, Mr. J. G. Sanders, who has added many interesting specimens in this group.

A somewhat larger specimen, similarly marked above, but with the face almost entirely black with very faint indications of light arcs, and under side of abdomen black, collected at Hyattsville, Md., by Prof. J. S. Hine, is also referred here.

DELTOCEPHALUS PICTUS n. sp.

Grayish, marked with lighter lines, head strongly produced, elytra with reflexed veins, upper half of face black, lower half yellow. Length of male, $3^{mm.}$.

Head produced, vertex about one and one-half times as long as broad, nearly flat, front broad, margins nearly straight, converging towards base of clypeus. Clypeus slightly longer than broad, tapering slightly toward rounded apex, cheeks nearly triangular, loræ rather broad, outer border semi-circular, margins of genæ almost straight. Pronotum with hind border straight, lateral margins very short. Elytra reaching nearly to tip of abdomen, three costal cross-veins reflexed, central anteapical cell constricted but not meeting at middle.

Color.—Gray, vertex with a black spot at apex including light yellow dot at tip, transverse fuscus band half way from apex to border of eyes, a darker transverse narrow band or line even with front border of eyes and two dusky stripes from near the center of each lateral area of the disc, connecting with similar colored bands on the pronotum, central impressed line distinctly marked, and black. Eyes gray, front black down to level of the eyes, with clypeus, loræ and cheeks light lemon yellow; scutellum with four dark dots on disc and faint fuscus stripe near lateral angle; elytral veins whitish, the borders on apical half strongly bordered with fuscus or blackish, and a rather distinct blackish spot at apex; beneath blackish with margins of thoracic and abdominal segments narrowly yellow, loræ and base of anterior femora blackish, remainder of legs yellowish with dusky spines and claws.

Genitalia.—Male valve short, transverse, plates broad at base, tapering uniformly to rather blunt point; pygofer very long, more than twice the length of plates, converging apically and passing the tip of elytra.

Described from one specimen collected on Staten Island, N. Y.

It is a very striking species and although only a single specimen is in hand it seems desirable to describe it.

THAMNOTETTIX BRITTONI n. sp.

Resembles *kennicotti* but narrower, somewhat lighter, markings of prothorax and elytra, especially in the male, less distinct. Length, female, $5.75^{mm.}$, male, $5^{mm.}$.

Vertex subangulate, about one and one-third as long at middle as at eye, transversely depressed on the disc, rounded over to front; front nearly twice as long as broad, with two round black points between the ocelli, tapering to clypeus; clypeus narrow, widening slightly to apical third; loræ extended, touching the margin; pronotum faintly, transversely striate, polished, posterior border almost straight; elytra translucent.

Color.—Fulvous brown, males a brighter golden fulvous, with yellow markings less pronounced. Female, with front of vertex, most of face, transverse band on the pronotum, prominent claval stripe from near the base to apical cells and body beneath the legs, yellow; elytral veins pallid; venter somewhat more golden yellow and sutural lines touched with sanguineous. In the male the yellow markings are very faint, the whole body suffused with golden fulvous. The two prominent round black spots between ocelli, on border between vertex and front, are perfectly visible from above.

Genitalia.—Last ventral segment of female nearly twice as long as the preceding; hind border rounded, slightly thickened at the middle, forming a slight and faintly notched median lobe which is slightly embrowned laterally. Male valve very short, plates broad at base, margins curving to form narrowed, acuminate tips reaching nearly to end of pygofer; border finely ciliate.

Described from one female and three male specimens received from Prof. W. E. Britton, New Haven, Conn., to whom I take pleasure in dedicating the species. Of these, one was collected by W. E. Britton, July 15, 1904; one by B. H. Welden and one by W. E. Britton, July 20, 1904; one by H. L. Viereck, July 6, 1904. The species bears a striking resemblance to *kennicotti*, but aside from smaller size and narrower body, has lighter color and lacks the black markings of the pleuræ and has a shorter female ventral segment.

THE FUNCTION OF THE PROVINCIAL MUSEUM.

C. C. NUTTING.

If the psychologists are correct when they tell us that civilized man is "eye-minded," it follows as a natural sequence that the easiest way to educate in regard to concrete objects is through the eye. While it is doubtless true that we have been influenced largely in the direction of eye-mindedness by the prevalent habit of reading, a habit which leads to a discrimination of small differences in form, it still remains a fact that the most direct and common appeal to the intellect is through the eye, and that we remember largely in terms of vision.

Thus it comes about that the two most important agencies in popular education are intended to appeal to the consciousness directly through the eye. These agencies are the library and the museum.

An enormous impetus has been given to the former through the princely and wise munificence of a single man, Mr. Carnegie, and the time will come when the importance of the second, the museum, will be recognized as widely as that of the library is at present.

Dr. Edward S. Morse, Director of the Peabody Academy of Sciences, has published a paper with the significant title, "If Public Libraries, Why Not Public Museums?" from which I quote the following:

"Lessons from books, and not from nature, have been the tiresome lot of school children. Questions and answers, cut and dried, have tended to deaden the enquiring spirit. That portion of the child's brain which is involved in observation has been reduced to atrophy by the usual public school methods." "I shall never forget the bitter disappointment I felt as a boy, on my first journey, when the stage driver pointed out to me with his whip the dividing line between the states of Maine and New

Hampshire. There was no colored line! There was no change in the color surfaces of the two sides! I felt grieved and rebellious at the imposition that had been practiced upon me." "The book method of education has almost paralyzed public desire for museums, and the result has been that the museum, when instituted, has been in the interest of specialists, and mainly through their efforts."

The museum, then, is an educational force that cannot be neglected. It should be regarded as of coördinate value with the library. This does not mean that it can ever supplant the latter, but that it can be its most effective supplement and aid, as Professor Goode, the ablest museum organizer that this country has ever produced, points out in the following words:

"I am confident, also, that a museum, wisely organized and properly arranged, is certain to benefit the library near which it stands in many ways through its power to stimulate interest in books, thus increasing the general popularity of the library and enlarging its endowment."

The meaning of "provincial museum," as used in the title of the present paper, needs some explanation. Museums may be classified in various ways. For instance, they are most commonly distinguished by their main contents, as Art Museums, Natural History Museums, Historical Museums, Commercial Museums, etc. On the other hand they can be classified in accordance with the power by which they are owned or controlled. This gives rise to the National Museum, owned and governed by the Nation. This should be, but often is not, the most dignified and comprehensive of all museums. In our country, however, there are at least three museums that are, or soon will be, much more extensive than the National Museum at Washington, even when the latter is installed in the proposed new building.[1]

Then there is what may be designated as the Metropolitan Museum, situated in a great city and controlled neither by the Government nor by a college or university. In this class would come the Carnegie Museum at Pittsburg and the Field Colum-

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1. Reference is made here to the American Museum at New York, the Carnegie Museum at Pittsburg, and the Field Columbian Museum at Chicago, each of which has buildings planned or already erected that will more than double that of the proposed new National Museum in capacity, and each of which is more munificently endowed than the latter.

bian Museum at Chicago. The American Museum in New York City is practically in the same class, but its connection with Columbia University excludes it from this group on technical grounds. These three institutions are, or soon will be, among the foremost in the world in point of size and endowment.

Again, we have the University Museum, such as that at Oxford or Cambridge in England and Harvard or Yale in this country, the primary function of which is to aid in the education of the college man, thus differing fundamentally from that of the National or Metropolitan Museum.

Lastly, we have the class which furnishes the subject for this paper—the Provincial Museum. The term is used in a not very exact sense, but is intended to include all of the public museums that are neither national, metropolitan nor university museums as defined above. Such institutions are necessarily more limited in scope than either of the other classes because they are not backed by the resources of a nation, a great city, or a university. They are limited in number in this country and have not as yet secured the public support that their real importance should command. In England there are a number of such institutions supported by public funds, and many of them are doing a work creditable to themselves and of recognized utility to the public. The "Hancock Museum" at Newcastle-on-Tyne is an example of a thoroughly dignified and useful museum of this sort. It is not large. Indeed, as I remember it, it is not very much larger than the Davenport Academy of Sciences Museum, but it contains much that is of very unusual interest, and its scope is almost exactly that which I am about to indicate as the ideal one for such an institution.

One has to look in vain for such a museum in our central states, the nearest approach to it being our own museum at Davenport. But the time is coming when such institutions will rank in aggregate importance with either of the other classes enumerated above.

In a report made by a committee to the British Association for the Advancement of Science, the following are set forth as the special objects of the Provincial Museum[1] of the United Kingdom:

"1. To contribute its share to the general scientific statistics

1 Report of the United States National Museum for 1893, p. 777.

of the country by collecting and preserving specimens of the natural and artificial productions of the district in which it is situated,

"2. To procure such other specimens as may be desirable for illustrating the general principles of science, and the relation of the locality to the rest of the world.

"3. To receive and preserve local collections or single specimens having any scientific value which the possessors may desire to devote to public use.

"4. So to arrange and display specimens collected as to afford the greatest amount of popular instruction consistent with their safe preservation and accessibility as objects of scientific study.

"5. To render special assistance to local students and teachers of science."

According to the views of the present writer, the functions of the provincial museum, as defined in this paper, are:

First. The securing of as complete a local collection as can possibly be obtained. This should, it appears to me, be the primary object of the institution. Ordinarily, however, it is the very last thing to engage the attention of the bodies governing such museums. The idea that we must ransack foreign countries for museum material of first-class value is a fundamental mistake. The primary object of the museum is the education of the people; and a complete, well-displayed and well-labeled series of the local fauna, flora and minerals will stimulate interest and impart information more quickly and surely than any other means.

It is a mistake to think that the people are not interested in familiar things. On the contrary there are no specimens that are more attractive to the average child or adult than the birds and flowers and insects familiar to him. Such specimens are a more welcome sight than those from foreign localities for the same reason that familiar human friends are more appreciated than strangers. A somewhat long and extended acquaintance with the public in its relation to a natural history museum has brought conviction of this fact to the writer, and any one who lingers long in a museum and watches the visitors will be inevitably forced to the same conclusion.[1]

[1] The writer would not have it inferred that he would exclude general collections from the provincial museum. On the contrary, the local series should be the nucleus

But it is not enough to have our local collection installed and displayed in the ordinary way, the specimens arranged in stiff rows, with equally stiff labels giving the technical names and localities, with, perhaps, the name of the donor.

Dr. F. A. Bather, in a paper with the somewhat whimsical title, "How May Museums Best Retard the Advance of Science?" says:

"None of us but has been taught how to bewilder the eyes of the public with thirty specimens of an object, all placed the same way up, and displaying as few of its essential characters as possible, when one specimen properly labeled would have sufficed. We know how to strike dullness through the hearts of thousands by our funereal rows of stuffed birds with their melancholy lines of Latin names."

The installation of collections has become a real art in modern museums, and nowhere has there been more striking advance than in the manner of showing to the public the things that we want it to see. The amount of thought and effort that has been devoted to this purpose has brought more reward to the conscientious curator than any other part of his work. The visitor merely feels that the effect is pleasing or tiresome, as the case may be, but does not realize that the difference between pleasing and tiresome is almost always and surely a difference in the method of installation. This has assumed the dignity of an art of recent years, and the most painstaking attention is given to such matters as background, illumination, cases, accessories and labels.

As regards the very important subject of labels, Professor G. Brown Goode has said: "An efficient educational museum may be described as a collection of instructive labels, each illustrated by a well-selected specimen."

In general it may be said that the aim of the provincial museum should be to install its specimens in such a way that the visitor will be pleased and not wearied, and that certain definite facts will be taught thoroughly and impressively. For example: The collection of birds should not be limited to a systematic series in monotonous rows, but should enforce the life history of a number

around which should gather typical specimens illustrating the relationships of the local material to that of the world at large. The local collections should, however, make a serious attempt at completeness, while the exotic material must necessarily be fragmentary, at least in comparison.

of familiar forms in such a way that the merest child can not fail to understand and appreciate it. Not only the adult form should be exhibited, but the young, the nest, and the eggs. If possible these should be combined in an artistic group that will be, above all things, correct in every detail. Then the label should tell the story simply and clearly. If the species is of either positive or negative economic importance, this fact should be stated together with the most effective means of encouraging the birds if of economic value, or of destroying them if harmful. Fortunately the latter will seldom be the case.

In addition to these concrete lessons, the museum can and should teach much regarding the general laws of nature. For instance, such matters as protective coloration, mimicry, geographical distribution, variation, etc., can be very effectively illustrated by definite examples taken from the familiar woods and fields.

Second. The securing and exhibition of a notable collection in some one field of science. In other words, some special "hobby" should find a place in every museum of any pretension.

Just what this special collection will be in any particular instance is more often determined by accident than design. The original curator of the institution may have been a specialist in some limited field, and hence the collection is fore-ordained to be built up in that particular direction. Again, it often happens that the founder of the museum has long been interested in gathering together material in some one field, and has donated this collection as a nucleus for the future museum.

In the case of the museum of the Davenport Academy there are two collections of special value—namely: The entomological collection, contributed by Mr. J. Duncan Putnam, and the very valuable anthropological collection, mainly from eastern Iowa and western Illinois, which can be regarded as almost unique in its scientific value. This latter seems destined to be the collection par excellence which will be forever associated with this very creditable museum; and it is, in my opinion, the feature that should be most energetically pushed and endowed by those in charge of the Academy. This collection should be jealously guarded and effectively displayed, and no effort should be omitted that will tend to add to its treasures or increase its efficiency.

Third. Our ideal provincial museum having decided on the policy of securing a good local collection and seeing that it is installed and exhibited in a pleasing and adequate manner, and having further decided energetically to pursue the plan of keeping up some special hobby, should see to it that the necessary accompaniment of the museum, the library, should not be neglected. With the limited means usually at the disposal of the provincial museum, there should be no attempt at providing books for the use of the general public, although this is very desirable. Books of a technical nature, embracing those scientific fields covered by the collections, should be added as rapidly as possible, so that the specialist may find his tools ready at hand when he enters upon the study of the museum material. It will be necessarily a long and laborious task to provide a good working library, even in a few limited fields of scientific endeavor. It seems to the writer that nothing so clearly demonstrates the long-headed wisdom of the founders of the Davenport Academy as does their persistent work along the line of building up a good scientific library. There are very few such well-selected collections of scientific works in any provincial libraries in America, and not many in Europe.

I say that this policy is essentially far-sighted because it makes it possible for the institution itself to engage in the making of books and other scientific tools. It is altogether probable that no part of the endeavor of any soundly organized society pays more surely and more amply than the publication of its Proceedings and Reports. For this at once ranks a given institution among the solid and serious forces at work for the advancement of science, and secures a certain recognition among the world-wide sisterhood of similar institutions. This recognition is not by any means a purely sentimental one, but at once begins to prove its practical value in the tide of literature that sets toward the library of the favored Society or Academy, a tide that is ever on the increase and which goes far toward filling the empty shelves of the book room.

Fourth. Having spread the feast of good things for the public and for the special investigator, having provided attractively displayed collections and a good working library, the next thing for the museum administration is to see to it that the collections

are brought into vital touch with the public for which they are prepared. It is not enough to have certain days or certain hours during which the rooms are open to the general public, but special means must be taken to insure not a casual but an habitual attendance of the people. Care must be taken that the visitors depart with a sense of having been distinctly pleased rather than with a feeling of weariness that will inhibit habitual use of the museum.

Most of the remarks in the preceding pages concerning methods of attractive installation are directed toward the securing of the pleased attention of the visitor, but there are other means that the wise curator will not fail to use, and which in the Davenport Academy have already been used most effectively. I refer to the establishing of close relations with the public schools of the city and surrounding region. I know of no instance where this object has been more thoroughly and admirably attained than here. It will not do for a provincial museum to content itself with attracting to its halls the scientific specialists, nor even securing the passing interest of the casual visitor; but an intimate contact with the public, a contact which means real service, is essential to any lasting success. If the teachers and pupils of the public schools are once brought to the point that they feel that they are distinctly benefitted by the museum and can be kept to a realizing sense of that fact, a foundation is laid for reciprocal benefits.

This leads us directly to a vital question relating to the welfare of the provincial museum, and that is the question of public support in a concrete, that is, a financial way.

No museum or other public utility can hope to have a healthy growth unless it have a certain support upon which it can count in advance. In my opinion it would be no very difficult task to defend the thesis that a municipal or provincial museum should be supported by taxation, just as most city libraries are now supported. There is no question but that so good and well-managed a museum as that owned by the Davenport Academy of Sciences would, in almost any community in England, be regularly supported by a stated tax. Every argument that can be brought forward to defend the proposition that public libraries should be supported by funds raised by taxation is equally available in favor

of a like support for properly conducted museums. Such a museum should be able to secure such support by virtue of services rendered, and the funds thus provided should be given as a right, and not doled out as charity. It is my belief that the services now being rendered by the Davenport Academy are of such real value to the community that the burden of its support should no longer fall entirely, or even mainly, on the generosity of private individuals. This institution has long ago passed the experimental stage, and has proved beyond possibility of cavil its potency for good service to the community. It is in a position to ask and receive regular financial support from the City of Davenport as a small return for a great service which has been continuously rendered for many years.

In conclusion the writer would plead the excuse of a somewhat long service in museum work as an apology for offering two suggestions regarding things that should not be done, although they very generally are done in the smaller museums everywhere.

The first of these things to be avoided is the purchase of specimens brought in by local collectors. If the museum is in a position to pay for everything, then nothing can be said against this practice. But it is safe to say that there are no provincial museums that are sufficiently endowed to be beyond the need of strict economy. The fact is that if it once becomes understood among the local sporadic collectors, particularly boys, that the museum will pay for specimens, it will almost invariably be compelled to pay for material which would otherwise naturally be freely donated. This course works a double injury. It prevents the museum from realizing a sure and constant revenue in the way of donated local specimens, and it also results in a most unfortunate attitude on the part of the local youth. The boys should be induced to collect and bring in specimens for the good of the museum and the public, instead of placing the transaction on the low level of a commercial enterprise. The public or individual will take a keener personal interest in an institution that it is actively aiding than in one that it simply regards as a possible source of revenue. Every boy, girl, or man who brings a specimen and donates it outright will then feel a direct personal interest in the collections. He will bring his friends to see the bird or other specimen that he has given, and thus there will be estab-

lished a community of interest and effort that no amount of mere buying and selling could ever effect.

Another thing to avoid is the acceptance of special collections with the understanding that they are to be kept separate from the other collections in the museum. Few things have caused more real distress to the conscientious curator than this form of incubus that is forever being pressesd upon his unwilling shoulders. On the other hand, there are few more insidious temptations than that held out to the trustees of a museum by the man who offers a really valuable collection as a gift, provided that it be given a separate room or case and bear the name of the donor. But the wise and experienced museum man will at once gently but firmly refuse any such donation, and in most cases a little frank explanation will convince the would-be donor that, if his object is to serve the public or the cause of science, he should make his gift absolutely free of any such conditions.

Nothing is more certain than that the acceptance of such a gift will sooner or later be regretted if the museum involved ever attains the dignity of a well arranged and well balanced exhibition of material. The curator will inevitably find that his well-planned schemes for a consistent display are forever being confronted by this ghost that will not down, and the result will be that he wishes that that particular collection, however valuable it once seemed, could be cast into the bottom of the sea, or anywhere else, so that it is forever out of his way. While it occasionally happens that a special collection is so nearly complete that it can logically be kept separate, such cases are so exceptional that they do not conflict with the general rule that should be rigidly adhered to in every museum that expects a healthy and long continued growth with elbow room for a correct system of installation.

STATE UNIVERSITY OF IOWA,
Sept. 18, 1905.

RECORDS

OF THE

DAVENPORT ACADEMY OF SCIENCES

1904–1906

1904

OFFICERS

Elected at Annual Meeting January 29, 1904

President,	A. W. Elmer
Vice-President,	C. H. Preston
Curator,	J. H. Paarmann
Recording Secretary,	A. A. Miller
Corresponding Secretary,	Miss S. G. F. Sheldon
Treasurer,	Miss Elizabeth D. Putnam
Librarian,	C. E. Harrison

TRUSTEES

COMMITTEES

Publication—Miss Elizabeth D. Putnam, C. H. Preston, Samuel Calvin, E. S. Hammatt, J. H. Paarmann.

Library—C. E. Harrison, J. H. Paarmann, Miss S. G. F. Sheldon.

Finance—W. C. Putnam, C. A. Ficke, E. C. Roberts.

Lectures and Entertainments—Miss Elizabeth D. Putnam, A. F. Ewers, A. A. Miller, C. E. Harrison, E. S. Hammatt.

Museum—Zoölogy, J. H. Paarmann; Conchology, Miss S. G. F. Sheldon; Botany, A. F. Ewers; Ethnology, Miss E. D. Putnam; Archæology, C. E. Harrison; Geology and Paleontology, Dr. A. W. Elmer.

REPORTS OF MEETINGS

January 29, 1904—Regular Meeting.

Voted that the Museum should be opened free one Sunday afternoon in each month.

The following memorial resolution was adopted:

In Memoriam.—Again must the name of a long-time member and trustee of this Association be transferred from the roll of its active workers to that of its honored dead. The genial, kindly presence of J. H. Harrison will henceforth be missed from our assemblings. Exemplary in every relation of life, pure of heart, esteeming honor incalculably above profit, he was one of those truly successful men who through altruistic service win their richest and most prized treasures.

Resolved, That this tribute of our love and respect be spread on the minutes of the Academy and a copy transmitted to the bereaved family with the assurance of our sympathy in their deep grief.

C. H. PRESTON,
C. A. FICKE,
A. A. MILLER,
Committee.

February 26, 1904—Regular Meeting.

J. H. Paarmann reported on the meeting of the Iowa Anthropological Association in Iowa City.

Standing Committees for the year were announced.

March 3, 1904—Trustees' Meeting.

Voted to send an exhibit to the Louisiana Purchase Exposition in St. Louis.

March 25, 1894—Regular Meeting.

Routine business and discussion.

April 5, 1904—Trustees' Meeting.

Routine business.

May 3, 1904—Trustees' Meeting.

Routine business.

May 18, 1904—Trustees' Meeting.

Voted to accept a proposition from the School Board, that the curator should devote half time to the public schools, the first and last ten weeks of the school year at the Academy and the intervening twenty weeks at the schools.

Voted that the curator's salary for the half time devoted to Academy work be fixed at $600 a year.

May 27, 1904—Regular Meeting.

G. R. Putnam, of the United States Coast and Geodetic Survey, gave a talk on the Philippine Islands.

September 30, 1904—Regular Meeting.

Routine business and discussion.

October 28, 1904—Regular Meeting.

Professor Frederick Starr was appointed delegate to the St. Louis Convention of the International Geographical Congress.

J. H. Paarmann reported on the Anthropological exhibit at the St. Louis Exposition; also that the Academy's exhibit of mound relics had been awarded a silver medal.

November 9, 1904—Trustees' Meeting.

Routine business.

December 30, 1904—Regular Meeting.

Routine business and discussion.

January 27, 1905—Annual Meeting.

Dr. A. W. Elmer, President, in the chair.

Reports of the officers and committees were read.

Officers for the year 1905 were elected.

REPORT OF THE CORRESPONDING SECRETARY FOR 1904.

The report of the Corresponding Secretary, Miss S. G. F. Sheldon, showed that arrangements had been made for the better handling of the Academy exchange list.

REPORT OF THE RECORDING SECRETARY FOR 1904.

The report of the Recording Secretary, A. A. Miller, noted the meetings, elections to membership, etc., during the year.

REPORT OF THE TREASURER FOR 1904.

GENERAL FUND—RECEIPTS.

Balance on hand January, 1904	$ 31.25	
Dues and subscriptions of members	686.50	
Subscriptions for improvements	500.00	
Interest from endowment fund	103.81	
Receipts, two lecture courses	632.76	
Income, Science Hall	160.00	
Door receipts	37.80	
Special gifts	1,126.30	$3,278.42

EXPENSES.

Salary of curator	$ 866.64	
Janitor	279.90	
Current expenses	445.75	
Expenses, two lecture courses	409.50	
Transportation and expenses, Palmer collection	240.00	
Bills for 1903	404.47	
Paid on note and interest on account building improvements	621.27	
Balance on hand January, 1905	10.39	$3,278.42

PUBLICATION ACCOUNT—RECEIPTS.

Balance on hand January, 1904	$ 271.14	
From Putnam Memorial Fund	570.00	
Interest from bank account	4.24	$845.38

EXPENSES.

Printing Proceedings	$ 435.00	
Illustrations for Proceedings	187.30	
Preparation of index to Proceedings	30.00	
Wrappers, etc., Vol. IX	11.97	
Balance on hand	181.11	$845.38

ELIZABETH D. PUTNAM, Treasurer.

ENDOWMENT FUND.

General Endowment	$2,200.00
Publication Endowment Fund (approximately)	125.00

In addition to these are the Putnam Memorial Fund, established by the will of Mary L. D. Putnam for publishing the Proceedings, and a bequest of J. Monroe Parker, not yet paid to the Academy. ELIZABETH D. PUTNAM, Treasurer.

REPORT OF THE LIBRARIAN FOR 1904.

The report of the Librarian, C. E. Harrison, for 1904, showed 1,112 accessions, of which 8 volumes were acquired by purchase, 368 by gift, and the balance by exchange. A list of missing numbers of serials has been prepared, as well as a check list on cards for keeping account of exchanges, both by Miss Sheldon.

REPORT OF THE PUBLICATION COMMITTEE FOR 1904.

The Publication Committee reported the completion of Volume IX of the Proceedings, at a cost of $1,056.65.

REPORT OF THE CURATOR FOR 1904.

In addition to giving an outline of the improvements needed in the museum, the curator reported as follows:

Work Accomplished During the Year:

Installation of the Palmer Collection of heads and horns.
Re-arrangement of the natural history collections.
Preparation and installation of an exhibit for the World's Fair at St. Louis.
Editing the material for Volume IX of our Proceedings.
Lectures to the school children.
Continuing the cataloguing of the library, writing for missing numbers of incomplete sets of serial publications, and making other improvements in the library.
Fitting up a room for the storing of our publications.

Summary of Donations:

Minerals	Several Collections
Fossils	6 specimens
Birds	8 "
Birds' eggs	40 sets
Mounted animal heads	42 specimens
Mounted animal horns	155 "
Other zoölogical specimens, about	400 "
Ethnographical specimens	106 "
Stone implements	200 "

Visitors to Museum (see appendix):

January	250	May	722	September	1,008
February	450	June	660	October	910
March	1 119	July	138	November	486
April	1,262	August	148	December	137

Total for the year, 7,290

ANNUAL ADDRESS OF THE PRESIDENT.

Ladies and Gentlemen—At the time of the discovery of America the whole of North America was inhabited by a wild nomadic race to whom was given the name of "Indians." This people was found to be divided into many tribes and federations, but were all of the same character and habits, slightly diversified, as they were influenced by climate and environment. Their houses and shelters were of the most primitive description, and they clothed themselves, where they found clothing convenient, in the skins of animals.

For food they depended mostly on the fruits of the chase and the natural products of the soil, with very little attempt at cultivation.

Each tribe dwelt within certain boundaries when not at war, but still moved about within these limits in search of game or as fancy might lead them. Their modes of sepulture were as crude as their modes of life, consisting in shallow graves or placing the remains on elevated platforms out of the reach of wild beasts, where time and decay brought both to mother earth in the end.

As the white races gradually occupied the land, it was soon observed that there were certain evidences of a more advanced development, and permanent habitation in the relics and works of a former race or generation.

These relics consisted mostly in earth-works such as are found the world over. In England they are called "Barrows" and associated with the Stonehenge, and in North Germany they are called "Hünengräber." They are mounds of various sizes, and were left by the ancient people of all countries. The prehistoric races of America left works over most of the Western Continent, in many instances in North America surpassing in size the Barrows of England and the North German graves, but differing in form and design from any found in other parts of the world. In Wisconsin, for instance, we find them taking the forms of men, beasts and birds, rudely sketched in embankments of earth many thousands of feet in extent. In Ohio are two monuments called "The Serpent" and "The Alligator," the names of which sufficiently describe them, and which attracted even the attention of the indifferent observers among the early settlers.

Many cities have received their names from the earth-works of prehistoric times in their vicinity, such as Moundville, W. Va., near which is one of the largest mounds on record, and Circleville, Ohio, where one of the curious forms of earth-works known as the "square and circle" suggested the name of the town.

In the Lake Superior copper region we find the remains of ancient mines worked by this people, and according to Newberry the lead mines of Kentucky and the oil wells of Canada and northwestern Pennsylvania were known to them and were to some extent developed.

Many of the mounds have been explored and most of them yielded nothing of interest, but in many instances there have been rich finds, including weapons of the chase and war, together with implements of domestic use, consisting of pottery, woven cloth, and charred remains of grain. The weapons are mostly of stone; but a few are of copper all flecked with silver, showing that they came from the Lake Superior region, as there copper is native and has this characteristic.

There has been much diversity of opinion as to the antiquity of these monuments and the possible origin of the people which left them; but it seems that the best accepted authorities consider them very old, and the race that they commemorate, one distinct from any found in these regions at the time of America's discovery. Certain it is that the oldest traditions of the Indian could not account for them, and no tribes found in the localities ever built such mounds or earth-works or even imitated them. The conclusion, therefore, is but reasonable that a very different race, or at least a generation of a very much greater degree of civilization, once inhabited the greater part of North America, and especially the Mississipi Valley.

MOUNDS OF SOUTHERN TEXAS.

With this introduction, the writer wishes to call the attention of the society to a certain peculiar variety of mounds found in the southern part of Texas and which, as far as he knows, have never been reported or described. The region in which they are found is a continuance of the Staked Plains, extending from the Mexican border and the Rio Grande along a plateau some 3,000 or 4,000 feet in elevation, to the north, where it broadens out into

the Llanos Estacados, or Staked Plains. This plateau is cut into deep cañons, some of them containing the beds of rivers, but most of them dry and running water only during the wet season and only for a few hours at a time.

These cañons are from 100 to 1,000 feet in depth, that of the Pecos being one of the deepest, while the Howard, extending nearly parallel for a hundred miles or so, deepens until it joins the Pecos fifteen miles from the river Rio Grande, and is fully 1,000 feet deep at the point of juncture. These great ravines are joined by side cañons which are again joined by others of the same kind until the country is an intricate network of depressions, deep and steep-sided, and of such intricacy that it makes it very discouraging for one to attempt extended excursions unless well acquainted with the country.

There is no rainfall during the greater part of the year; but during the early months of summer there are downpours which, draining from the slopes as from the roof of a house, produce torrents which sweep everything before them; but the watercourses are again dry in a few hours, and water must be obtained from wells as soon as a few days' evaporation has dried up the natural pools. The ranchmen are obliged to drill wells from 200 to 600 feet in order to get water, and in places it has not been found even at 1,000 feet, and windmills are required to bring it to the surface. There is no chance for existence for man or beast a greater part of the year where these wells are not located.

There is very little soil and the vegetation is consequently scanty and of such character that only the native cattle can exist upon it eight months out of the twelve. Much of the surface is bare limestone where even the cactus cannot grow.

One would scarcely expect to find the remains of former inhabitants in such an inhospitable country, yet over this region are scattered the peculiar mounds before mentioned. They are not built of earth, as are the mounds of other localities, but are almost entirely constructed of stone, not mere stone heaps carelessly piled together nor laid so as to form any structure, but piled into regular, symmetrical mounds, and composed of stone broken into fragments all of about the same size. One is at once reminded of the macadam which is used on our roads and streets, and the mounds contain all the way from a dozen to fifty or more wagon-loads of this material. Mingled with the stone is a blackish earth, seemingly darker and richer than the surrounding soil, and forming a compact mass, over which grows the sparse vegetation found here.

These works are found mostly in the mesa, or upland, but to some extent they also occur in the shallower side cañons. In some instances they appear to be situated quite a distance from the source of the material of which they are made, and in others they lie among the limestone fragments and are only distinguished by the regularity of the stones which compose them.

They are mostly isolated, but are also found in groups, and occur at frequent intervals along the junction of the cañons and, as before mentioned, in the higher side depressions.

There is a very interesting group of these mounds about a cave on the range of Fred Wilkins of Val Verde county. The mounds were the largest seen in this whole region, being some five or six feet high and having a circumference of thirty or forty feet. They lie overlapping one another, as though the builders were short of space, and completely surround the entrance to the cave. At present the cavern shows but little room for habitation, but from appearances it was formerly much more extensive than now. The roof has fallen in at the inner end so that it has the appearance of having been filled up with earth and limestone débris. Why the mounds should have been built here so extensively is not very clear unless at some former time water was to be found within the depths of the cave, but at present it would offer neither shelter nor water.

An exploration of these mounds and the cave would doubtless give inter-

esting results, but would require considerable time and expense, being so far removed from the railroad and so difficult of access.

The few mounds which have been explored have yielded nothing of interest, but the investigation has been only cursory and superficial and therefore no indication that nothing is to be found in them. Most of the mounds in Arkansas and in other parts of the country contain no remains, just as might be expected from their great age. Under especially good conditions some parts of skeletons are found in the mounds opened throughout the states, but in many instances they are evidently of later date than the original builders, as it is well known that the Indians used the mounds as they found them as resting places for their dead, and excavators have taken these remains to be those of the original occupants.

That nothing has been thus far found in these stone mounds is, then, no argument that they are not the remains of an early race, but rather evidence of their antiquity, and more extended exploration will surely bring to light something of interest belonging to them. The mystery about these works lies in their distance from water and in the inhospitable conditions of the country. During most of the year the nearest water to some of the locations is not nearer than twenty miles, and yet the size of the mounds show that there must have been prolonged stays in their vicinity, where water is not known, and any food plants scarce during most of the year.

The Mexicans claim that the mounds were made by the Indians for the purpose of roasting sotol, a plant growing all about this region, having a thick, bulbous base, rich in starch, and which is sometimes used as food by the natives. This claim is manifestly absurd, as no such labor would need to be expended in making a mound of stone for this purpose, and the utility of such work for such an end is not in the least manifest. Were these monuments found only on the watercourses, or near the few springs, we might account more easily for their presence; and we can only conclude that the climate conditions must have been different when this mysterious people lived and died among the cañons of the Pecos in southern Texas.

WORK OF THE ACADEMY.

With 1904 ended a very satisfactory year for the Davenport Academy of Sciences. In all its departments there has been more than usual activity, and its financial prospects are steadily improving under the management of our able treasurer.

Many valuable specimens have been added to the museum, chief among which is the remarkable collection of heads and horns donated by D. D. and B. J. Palmer. This collection enables the observer to make a scientific comparison between the heads and horns of various animals, both as weapons of offense and defense, and ornamental head-dress. Among the antlers of the cervidæ are found the many curious anomalies peculiar to these annual growths, and the interlocked heads of the battling bucks give an idea of one of the tragedies of plain and forest.

The collection of mounted birds in the museum is growing very rapidly and is now probably, to the general visitor, the most interesting part of the exhibit. There have been many donations to this department during the year, and we have been notified by C. A. Ficke that he has shipped the Academy a collection of mounted birds from the far-away and interesting land of Japan. Other donations too numerous to mention have been received, among which are the archæological and zoölogical specimens given by Mrs. Anna Wuestenberg, collected and owned by her late lamented son, Otto H. Wuestenberg.

The library has been increased by many additions, some by purchase but mostly by generous donations, and under the management of our corresponding secretary have been so well catalogued and listed that they are accessi-

ble to the reader and can be readily reached for sale or exchange where there are duplicates.

There have been the usual number of meetings during the year, with good attendance, and besides the regular lecture course we have been favored with two addresses, one on the Philippines by George R. Putnam, and one on the anthropological exhibit at the World's Fair in St. Louis by J. H. Paarmann. The regular lecture course has been particularly successful both as to attendance and general interest as well as remunerative to the society, while the course of instruction to the school children has become a part of the public school training and gives our Academy an undisputed place among the institutions of education. This has been a long wished for consummation and was first originated and worked for by our late president, Mrs. Putnam, and undoubtedly is the most important part of our labors. That we have attained this point is most gratifying, and there is no doubt but that our field of usefulness will open wider and wider as time goes on.

During the summer past we have given the world a chance not only to learn of us but to learn *from* us in the exhibit placed in the ethnological department of the Louisiana Purchase Exposition at St. Louis. A silver medal was awarded us for this, which has become one of our valuable possessions, and will represent to future generations the work of the society in the early years of the twentieth century.

We have lost two members during the past year, J. J. Humphrey and Capt. W. P. Hall. In each we have lost a good friend, but in the latter we have lost much more. Capt. Hall was not only a friend to our institution, but was an integral part of it, and the Academy became a part of him, in his thoughts and deeds. During the most vigorous years of his life he devoted his whole time to the exploration and excavating of the mounds of the Mississippi Valley for the benefit of our musuem, as every shelf will testify, and in his later and failing years he never lost an opportunity of acquiring, by gift or purchase, any specimen which came within his notice for the same purpose. As long as the Davenport Academy of Sciences stands it will owe a debt of gratitude to Capt. W. P. Hall for the generous and single-hearted zeal with which he labored for its advancement.

1905.

OFFICERS

Elected at Annual Meeting January 27, 1905.

President,	A. W. ELMER
First Vice-President,	C. A. FICKE
Second Vice-President,	C. H. PRESTON
Curator,	J. H. PAARMANN
Recording Secretary,	A. A. MILLER
Corresponding Secretary,	MISS S. G. F. SHELDON
Treasurer,	MISS ELIZABETH D. PUTNAM
Librarian,	C. E. HARRISON

TRUSTEES

COMMITTEES

Publication—Miss Elizabeth D. Putnam, C. H. Preston, Samuel Calvin, E. S. Hammatt, J. H. Paarmann.

Library—C. E. Harrison, J. H. Paarmann, Miss S. G. F. Sheldon.

Finance—W. C. Putnam, C. A. Ficke, E. C. Roberts.

Lectures and Entertainments—Miss Elizabeth D. Putnam, A. F. Ewers, A. A. Miller, C. E. Harrison, E. S. Hammatt.

Museum—Zoölogy, J. H. Paarmann; Conchology, Miss S. G. F. Sheldon; Botany, A. F. Ewers; Ethnology, Miss E. D. Putnam; Archæology, C. E. Harrison; Geology and Paleontology, A. W. Elmer.

February 24, 1905—Regular Meeting.

A. W. Elmer and J. H. Paarmann were appointed delegates to the meeting of the Iowa Society of the Archæological Institute of America to be held in Iowa City.

J. H. Paarman reported on the meeting of the Iowa Anthropological Society held in Iowa City, February 17-18, 1905.

March 31, 1905—Regular Meeting.

The following papers were presented for publication and referred to the Publication Committee:

"The Aftonian Gravels and their Relations to the Drift Sheets in the Region about Afton Junction," by Prof. Samuel Calvin, of the University of Iowa. [Published in the Proceedings, Vol. X.]

"A Comparative Study of the Vegetation of Swamp, Clay, and Sandstone Areas in Western Wisconsin, South-eastern Minnesota, and North-eastern, Central and South-eastern Iowa," by Prof. L. H. Pammel, of the Iowa State College, Ames, Iowa. [Published in the Proceedings, Vol. X.]

May 26, 1905—Regular Meeting.

A paper on the "Fishes of Hong Kong," by Dr. David Starr Jordan, of Leland Stanford Jr. University, was presented for publication and was referred to the Publication Committee. [Published in the Proceedings, Vol. X.]

Edward K. Putnam, of Leland Stanford Jr. University, California, read a paper on "The Value of Natural History to the Student of English."

June 30, 1905—Regular Meeting.

J. H. Paarmann exhibited a case of seventeen-year locusts collected by Miss Sheldon in Fejervary Park, showing different stages of development.

September 29, 1905—Regular Meeting.

A. W. Elmer reported that he had opened two mounds during the summer, but had found nothing of importance.

A. A. Adams, Director of Manual Training Department, Davenport Public Schools, lectured on "Travels in Mexico," illustrated by lantern slides. The lecture described the people, their manners, customs, and dress.

October 27, 1905—Regular Meeting.

The following papers were presented for publication and referred to the Publication Committee:

"Some Coccidæ from the Philippine Islands," by Prof. T. D. A. Cockerell, of the University of Colorado. [Published in the Proceedings, Vol. X.]

"Provincial Museums," by Prof. C. C. Nutting, of the Universty of Iowa. [Published in the Proceedings, Vol. X.]

Miss Bush gave an account of her work of preparing Indian stories for primary children. She had found much material in the Academy library.

The report of the mound exploration party showed that five mounds were opened near Dixon, Iowa, with no finds except some badly decomposed bones in the mound in Clinton county.

November 24, 1905.

C. A. Ficke gave a lecture on "Japan" at the Grand Opera House. No business meeting.

December 29, 1905—Regular Meeting.

The following papers were presented for publication and referred to the Publication Committee:

"The Drone Fly," by Baron C. R. Osten Sacken, of Heidelberg, Germany. [Published in the Proceedings, Vol. X.]

"On Certain Fossil Plant Remains in the Iowa Herbarium," by Thomas H. Macbride, of the University of Iowa. [Published in the Proceedings, Vol. X.]

"Descriptions of New Forms of Jassidæ," by Herbert Osborn, of the Ohio State University. [Published in the Proceedings, Vol. X.]

Voted to offer the Davenport Public Library any duplicates the Academy had that the Library could use.

January 10, 1906—Trustees' Meeting.

W. C. Putnam and Elizabeth D. Putnam, trustees of the Putnam Memorial Fund, under the will of the late Mrs. Mary L. D. Putnam, presented the following report:

REPORT OF THE PUTNAM MEMORIAL FUND.

The undersigned, Elizabeth D. Putnam and W. C. Putnam, have the honor to report that W. C. Putnam, the legal trustee of the Putnam Memorial Fund under the will of Mary L. D. Putnam, deceased, has received the sum of twenty-four thousand ($24,000) dollars (approximately) from the estate of Mary L. D. Putnam, deceased, and now holds this sum invested for the benefit of the Davenport Academy of Sciences under the provisions of said will. It is provided in this will that the distribution of the income of the Putnam Memorial Fund shall be under the control of a board of three (3) trustees, two of these being the undersigned named in the will and the third to be chosen by the trustees of the Academy. And these trustees would now ask that they place the name of Hon. C. A. Ficke to fill the vacant place on this board.

ELIZABETH DUNCAN PUTNAM.
WILLIAM CLEMENT PUTNAM.

The report was accepted and Mr. Ficke was elected.

The Finance Committee presented the following report:

REPORT OF THE FINANCE COMMITTEE FOR 1905.

The undersigned, chairman of the finance committee, has the honor of presenting to the Davenport Academy of Sciences and to its board of trustees their report of its operations for the past year. It shows that by strenuous efforts the Academy was at last enabled to pay off all its debts and close its books without owing a dollar in the world, directly or indirectly. This is probably the first time since the founding of the Academy nearly forty years ago, that this could be said in connection with this report. The com-

mittee desires to state that the grounds and buildings of the Academy, which consists of a frontage of 190 feet on Brady street by 140 feet on Seventh street and improvements thereon, are all in splendid repair and condition. And futhermore, that the general endowment fund of the Academy consists as follows:

General endowment	$ 2,200.00
Putnam Memorial Fund	23,928,49

and in addition a bequest of $1,000.00 from the estate of the late J. Monroe Parker not yet paid over to the Academy. So we feel that the Academy is to be congratulated on its splendid financial condition, but people must remember that this is only a means for accomplishing still greater ends in the future, in developing the internal work of the Academy in providing new cases and apparatus and assisting in the important work of the Academy in the schools.

Respectfully submitted,

W. C. PUTNAM,
Chairman Finance Committee.

January 10, 1906—Annual Meeting.

A. W. Elmer, President, in the chair.

The annual reports of the officers were received and filed and the President's address read.

Officers and trustees were elected.

The President-elect, C. A. Ficke, upon taking the chair, spoke of the creditable position held by the Academy in the community and urged that all join in an effort to add one hundred new members.

REPORT OF THE CORRESPONDING SECRETARY FOR 1905.

The report of the Corresponding Secretary, Miss S. G. F. Sheldon, showed that many missing numbers of serials had been secured and that Vol. IX of the Proceedings had been distributed and a number of institutions added to the exchange list.

REPORT OF THE RECORDING SECRETARY FOR 1905.

The report of the Recording Secretary, A. A. Miller, recorded the meetings, elections to membership, etc., during the year.

REPORT OF THE LIBRARIAN FOR 1905.

The report of the Librarian, C. E. Harrison, showed 1,637 accessions for the year. Donations had been received from Miss J. E. Sanders, the Misses Decker, Miss E. D. Putnam, Miss S. G. F. Sheldon, and C. G. Plummer. A number of handbooks, useful for the educational work of the Academy, had been purchased.

REPORT OF THE TREASURER FOR 1905.

RECEIPTS.

Cash on hand January 31, 1905	$ 10.39	
Initiation fees, subscriptions and dues	849.50	
Gifts, donations and bequests	435.00	
Subscriptions to building fund	75.00	
Interest	186.61	
Income from Science Hall (net)	141.30	
Museum door receipts	39.20	
Museum contributions	5.20	
Sale of duplicate books, etc	30.65	$1,772.85

EXPENSES.

Salary of Curator	$ 600.00	
Salary of Janitor	250.00	
Water	21.12	

Plumbing	81.15	
Books	38.17	
Gas and electric light	27.45	
Fixtures	9.50	
Fuel	74.54	
Repairs	55.81	
Sundries	9.60	
Bills payable (note and interest)	409.64	
Binding	21.05	
Birds and taxidermy	36.95	
Photographs	6.00	
Archæological Institute, two memberships	20.00	
Freight and express	7.53	
Supplies	15.65	
Balance on hand January, 1906	88.69	$1,772.85

PUBLICATION ACCOUNT—RECEIPTS.

Balance on hand January 31, 1905	$ 181.11	
Income Putnam Memorial Fund	1,770.00	
Interest from bank	3.99	$1,955.10

EXPENSES.

Printing, electrotyping and binding	$ 957.85	
Distribution of Proceedings	57.30	
Drawings	199.88	
Balance on hand January, 1906	740.07	$1,955.10

ENDOWMENT FUND.

General Endowment	$ 2,200.00
Publication Endowment Fund, approximate	125.00

In addition to this are the Putnam Memorial Fund, established by the will of Mary L. D. Putnam for publishing the Proceedings, and a bequest of J. Monroe Parker, not yet paid to the Academy.

ELIZABETH D. PUTNAM, Treasurer.

REPORT OF THE CURATOR FOR 1905.

The curator, J. H. Paarmann, discussed the needs of the museum, and reported in part as follows:

IMPROVEMENTS IN THE MUSEUM.

During the past year a large number of new specimens have been installed. A beginning has been made in collecting an exhibit illustrating the native trees of our state. For this purpose it is desirable to display wood, bark, leaves, fruit, and pictures showing the characteristic mode of growth of each species. Portions of the trunks of sixteen species of trees, collected by Prof. L. H. Pammel of the Iowa State Agricultural College, are now on exhibit in the museum.

The Eskimo exhibit, consisting of articles illustrating the dress, hunting implements, household utensils, and boats of the Alaska and Greenland Eskimo, has been increased by a large loan collection of Eskimo clothing deposited in the museum by G. M. Cole.

The Academy may justly be proud of its shell collections, which are probably more complete than those of any other group in the museum.

RELATION OF THE ACADEMY TO THE SCHOOLS.

There are several ways in which the Academy may be of use to the schools. As teachers of the elementary schools become more familiar with the Academy library they realize that from its shelves they may draw much that will be helpful in the teaching of geography, history, and nature study; while to the science teachers of the High Schools and Colleges of the tri-cities the library is an invaluable help. The museum offers to almost all classes of teachers material with which to illustrate their lessons. How much more vivid, for instance, a picture of Eskimo life becomes to the little children when the words of the teacher, pictures, and text-book are supplemented with the real objects made and used by these people. I believe there is not a more useful field for the Academy than helping teachers to obtain

material with which to illustrate their lessons in geography, history, nature study, and other subjects.

Besides offering to the schools its library and museum the Academy seeks to aid in developing interest in the study of nature by offering courses of instruction to the school children. For several years lessons were given to classes at the museum whenever teachers made application to the curator for the same.

In 1904 the School Board of the City of Davenport voted to employ the curator of the Academy for one-half time to teach science in the public schools of the city. Since September, 1904, therefore, the forenoon of each school day has been spent in giving instruction and the remaining time has been devoted to the Academy. The work was at first in an experimental stage. Two questions came up: How many and which grades should receive this instruction? Should the lessons be given at the museum or at the schools? It seems to me that with the amount of time now at our disposal the best results may be obtained by confining the work to the upper grades, say from the fifth to the ninth, inclusive. Much of city life is artificial and opposed to the symmetrical and healthy development of mind and body. From the kindergarten to the post-graduate course in the university excellent opportunities are afforded for the study of nature. In the kindergarten are the nature games; in the first four or five grades the language lessons about trees, flowers, and animals; in the high school and university, required work in some natural science; but in the latter half of the elementary school course, especially the upper grades, nature study at present receives very little attention. In answer to the second question I should say that most subjects can be better taught at the schools than at the museum. There are, of course, exceptions to this rule, as where the nature of the specimens to be studied, on account of size or number, prevents their being taken from school to school. In such cases classes would have to come to the museum. When lessons are of such a nature that specimens lend themselves to being carried, then I should give the lesson at the school for the reason that much time is saved, as five school-rooms may be visited in half a day, while but one class can profitably receive instruction at the museum during the same time.

VISITORS TO THE MUSEUM.

(See Appendix).

ADDITIONS TO MUSEUM.

	NO. SPECIMENS.		NO SPECIMENS.
Ethnography	17	Corals	44
American Archæology	8	Insects	1
Egyptian Archæology	1	Other Zoölogical specimens	7
History	5	Botany	66
Mammals	6	Minerals	3
Birds	66		

Several hundred specimens of Periodical Cicada (seventeen-year locusts) showing different stages from the eggs to the adult form were collected.

ANNUAL ADDRESS OF THE PRESIDENT.

Ladies and Gentlemen—As each year brings its failures and successes, they are fortunate who are able to find a balance on the side of success, be it ever so small; but most fortunate are they who at the end of the year find their failures few and their successes many.

The Davenport Academy of Sciences leaves another milestone behind on a road of prosperity, and can look from accomplished work and achieved success to new aims and higher ambitions for the coming year.

We find there has been a marked increase in the number of visitors to the museum and library during the last twelve months, which can be taken as

the surest indication of the interest taken in our institution by the public, and the number of donations to both gives evidence of the hearty good will which is constantly shown us.

The monthly meetings have been held with more than usual regularity, and the attendance has been above the average, while many of our meetings have been made instructive as well as entertaining by means of papers and illustrated lectures.

There has been considerable increase in the membership, and the Academy has acquired some very valuable members, both at home and abroad, who will help to shape our future with their work and add their names to our roll of honor.

Our work in the schools has met with deserved recognition, an interest in the natural sciences has been shown by the pupils of the public schools, which is most gratifying; and the society has assumed and holds a place in educational work worthy of its resources, with promise of more extended fields of operation in the years to come.

The lecture course, as in the past years, has proven a success, and this feature of our labors bids fair to rival the work done in the schools, from an educational standpoint, reaching as it does the minds of maturer years, and presenting knowledge in a way that is both pleasure-giving and instructive.

For the first time in many years we are able to say that our society is free from debt, our obligations all canceled, and a fine property assured to us which will make possible any extension the growth of museum and library may make desirable.

That we have been able to acquire this property at so little sacrifice is due in the first place to our lamented president, Mrs. Putnam, and in the second to the generous effort of two of our members who have had the welfare of our Academy at heart and have spared no exertion or expense to make it possible to say today that we are out of debt. There are many who have contributed liberally, both among our members and our friends, and to them too is due much of the credit; and while we thank them one and all, we still owe the greatest part of our gratitude to Miss Putnam and to the Hon. C. A. Ficke.

Our publications are being put out as fast as the matter is ready for the printer, and this very important part of our work has been carried on under the able direction of our publication committee, crystalizing and condensing the results of our annual efforts into the neat volumes of our publications.

During the summer there were some attempts made to renew the archæological investigation of our region, and on two occasions mounds were opened in Clinton county, one of which the writer begs to report. The location of the group of mounds visited at the time is on the bank of the Wapsipinicon River in Clinton county, section 13, range 1 east, and township 81 north, in Spring Back township. These mounds are situated along a high ridge overlooking in part the old bed of the river and terminating in a high, abrupt bank, the foot of which was washed by the waters of the river in time out of memory before its course changed. The mounds were distributed in groups and singly along this ridge for nearly half a mile, and before the plow and harrow effaced them fifteen or twenty of these tumuli might have been counted over this extent. When the land was first taken up a house was built on the site of the most prominent group, and the changes which have taken place since then in remodeling and rebuilding dwellings, barns and other outhouses have now obliterated all trace of what was the most interesting part of these ancient works. Within the writer's memory some of these mounds were yet some six or eight feet high, with a diameter of fifteen or twenty feet. All these have now been leveled off with the surrounding surface, leaving no means by which to locate where they once stood or to direct where to excavate in order to find what may have been placed beneath their foundations.

Through the kindness of Mr. Henry Ficke of Wheatland it was made possible to open two of the mounds at the farther end of this group where they overlook the present course of the river on the farm of Fred Rowald. It was with extreme difficulty that the outlines of these mounds could be traced, as the fields in which they lie have been under constant cultivation for more than fifty years, and where twenty-five years since they were still several feet high and very clearly outlined, they are now so little above the common level that they blend in outline with the curves of the hill and their location is made well nigh impossible. In fact, had it not been for a previous knowledge of their location, gained in former years, they would undoubtedly have escaped notice.

A trench was opened through each mound from north to south and another was made at right angles to the first, what seemed the longest diameter being taken for the first trench. At the junction of the trenches in both mounds bones were found after the first few strokes of the spade, which unhoped for good luck made subsequent proceedings much lighter than might have been expected. A stone knife and an arrow point were the only finds in the second, but the location of three layers of bones in the first was more interesting. The first found were so near the present surface that the plow had disturbed and brought them to light. The next layer was about a foot below the first, but lying in a different direction, while a third skeleton was found, in part at least, four feet below the first and extending also in a different direction from the other two. No stone weapons or instruments were found here, but throughout the mound were found small bits of charcoal and fragments of stone, all of the same character, as if this peculiar variety may have had some purpose in the burial rites. Nothing was found of interest in the second mound save a single layer of bones at about the level of the second burial in the first, with the same fragments of stone and charcoal dispersed throughout, together with the knife and arrow point above mentioned.

The lowermost bones in the first mound must, at the time of its completion, have been something like eight feet below the surface, while the topmost interment was at about the general surface level. All through the fields in this region, and especially where the mounds are situated, arrow heads and other stone weapons or implements have been found for many years, and flint flakes may still be seen after every rain scattered in profusion over the surface. Many of the mounds have been opened in former years by the farmer boys and many relics taken from them, but there is no account of any metal of any description being found, and the absence of iron in any shape would tend to prove that the mounds were erected before the advent of the white man, probably centuries before, as in many places the bones can only be followed by an ash-like trace in the earth so complete is the disintegration. A few hundred years since in this locality there was a community teeming with life and activity which has disappeared, leaving only these earthworks to tell that they once lived and but a few years more and there will be no trace of them left, and even that their monuments once were here will be forgotten.

Death has again claimed for his own from our membership, and we mourn the loss of Dr. J. W. H. Baker and Mrs. J. B. Phelps. In the former we have lost one whose long and useful life made him a shining example of all that is good, kind and skillful as a physician, and generous, clear-headed and conscientious as a citizen; in the latter we have lost a good woman and a good friend of the Davenport Academy of Sciences.

In giving over the cares and responsibilities of the office with which the Society has honored the writer the past two years, it might be well to call attention to the fact that we are at present deficient in original work and investigation along certain lines which our location makes possible and even advantageous. Our adjacent quarries afford a fine field for palæontology,

the flora of our adjoining fields and the woods and meadows of the Rock Island Arsenal offer a wide range to the botanist, and the many earthworks of a vanished race still untouched in our vicinity leaves room for archæological investigation in which our Society once held the foremost position in the state, and possibly in the country at large. Formerly our members discovered and named fossils; described plants new to science, or gave to the world the secrets of unknown insect life, and today while we can no longer boast a Barris, a Parry or a Putnam in these sciences, we must still have those among us who, fired by their example, might, with the help our museum and library, take any of these branches and win for themselves a name in the scientific world and gain further honors for the Davenport Academy of Sciences.

1906.

OFFICERS

Elected at Annual Meeting January 10, 1906.

President,	C. A. FICKE
First Vice-President,	C. E. HARRISON
Second Vice-President,	HENRY MATTHEY
Corresponding Secretary,	MISS S. G. F. SHELDON
Recording Secretary,	A. A. MILLER
Treasurer,	MISS ELIZABETH D. PUTNAM
Librarian,	A. F. EWERS
Curator,	J. H. PAARMANN

TRUSTEES—EX-OFFICIO

President, C. A. FICKE Treasurer, MISS E. D. PUTNAM
Recording Secretary, A. A. MILLER

TRUSTEES

W. L. ALLEN	DR. JENNIE MCCOWEN
A. F. CUTTER	J. H. PAARMANN
A. W. ELMER	C. H. PRESTON
A. F. EWERS	W. C. PUTNAM*
E. S. HAMMATT	E. C. ROBERTS
C. E. HARRISON	MISS S. G. F. SHELDON

COMMITTEES FOR 1906

Publication—Miss Elizabeth D. Putnam, C. H. Preston, Samuel Calvin, E. S. Hammatt, J. H. Paarmann.

Library—Edward K. Putnam, J. H. Paarmann, Miss S. G. F. Sheldon.

Finance—Nathaniel French, M. N. Richardson, J. H. Hass.

Lecture—Miss Elizabeth D. Putnam, A. F. Ewers, A. A. Miller, C. E. Harrison, Charles Grilk.

Museum—History, C. M. Waterman; Ethnology, Miss E. D. Putnam; Conchology, Miss S. G. F. Sheldon; Zoölogy, A. W. Elmer; Botany, A. F. Ewers; Geology, H. E. C. Ditzen; Archæology, C. E.Harrison.

Program—J. H. Paarmann, W. D. Wells, L. F. Guldner.

January 15, 1906—Special Meeting.

Voted to close the Academy on January 17th, the day of the funeral of the late W. C. Putnam.

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*Died January 13, 1906.

Voted to adopt the following resolution:

In the death of William Clement Putnam, which took place at his home in this city, January 13th, 1906, the Davenport Academy of Sciences has suffered the loss of a most helpful associate and adviser. Deeply interested in its welfare and wisely active in its counsels from his boyhood, he accepted as a filial trust the burden laid down by his honored mother, and together with his sorrowing sister has since given to its interest the most watchful care. To his wise business management are very largely due the Academy's present prosperity and usefulness.

To business talents and legal ability of a high order Mr. Putnam joined rare scholarly tastes and the purest integrity. Public spirited, and having the best interests of the community deeply at heart, his many beneficent activities will be sadly missed.

Recognizing the Academy's great loss in his untimely death, be it

Resolved, That this expression of our high esteem be transmitted, together with the assurance of our deepest sympathy, to the bereaved family, and that it be spread on our minutes for publication in our Proceedings.

C. H. PRESTON,
A. W. ELMER, } Committee.
C. A. FICKE,

January 29, 1906—Trustees' Meeting.

Voted to authorize the President to act for the Trustees in legal matters connected with the probate of the will of the late W. C. Putnam, by which his estate will eventually go to the Academy.*

January 29, 1906—Regular Meeting.

The President, C. A. Ficke, referring to the death of W. C. Putnam, spoke in part as follows:

You will recall how, just five years ago, when the Academy, on its thirty-third anniversary, opened Science Hall, which it acquired chiefly through the efforts of Mrs. Mary L. D. Putnam, that noble woman made an earnest appeal for an endowment of $50,000 for the Academy in order that its usefulness might be enlarged and its valuable museum and library might be properly cared for and enlarged. Search where you will and where can you find a more beautiful and inspiring example of filial love and devotion than that which we behold in the response that was made by her own son to this appeal. This son, William Clement Putnam, although professional and business interests were taxing his time and energies to the utmost, during her life not only gave cheerfully and unstintingly of these, but of treasure, too, in support of the institution his mother so dearly loved. Upon her death, in loyalty to her memory he redoubled his efforts in behalf of that institution and thenceforth until his own untimely death, like his sister, Miss Elizabeth D. Putnam, was indefatigable in building up the Academy and developing its usefulness upon the lines planned by their mother.

But note the climax. When he came to meditate upon the question, what would become of the institution to whose upbuilding his mother had given the best years of her life when he no longer in person should be able to guard its interests and watch over its welfare, he penned that memorable document in which he answered the appeal made by his mother at the opening of Science Hall. He gave the Academy not only the $50,000 asked for, but gave to it property valued at many times that sum. I repeat, you will search in vain for a more inspiring example of filial love. And to add to the beauty of their mother's loyalty to an institution dedicated to the advancement of learning, and to their brother's loyalty to both mother and this institution, an equally devoted daughter, and equally devoted sons, applaud from the depth of their heart the noble response of their brother to the appeal of their mother.

But, with this noble gift to our institution, there comes not only to us, its members, but also to the people of our city and state, a solemn duty. That duty is to guard with never ceasing vigilance the interests of this institution;

*The portions of the will of W. C. Putnam relating to this bequest to the Davenport Academy of Sciences are published with his memoir at the beginning of this volume. The entire will is also published as a separate pamphlet.

to be ever mindful of the high purposes for which it was established; to develop it on the broad lines on which it was planned by its founders and on the yet broader lines on which it was being built up by its benefactors; to make it in the truest sense of the word an institution for the increase and diffusion of knowledge among men; to make it a center of science and art.

February 23, 1906—Regular Meeting.

The first clause of Article II of the By-Laws was amended as follows:

Regular members shall be elected in the manner hereinafter prescribed. Candidates for regular membership must be recommended, in writing by two members, and shall be proposed at a regular meeting, and balloted for at a subsequent regular meeting. The business of the Academy shall be managed by, and its officers elected from, the regular members.

Also voted to repeal the next to the last clause of Section 5 of Article II, reading as follows: "Every regular member shall be subject to an annual fee of three ($3.00) dollars, commencing on the 1st of January first following his election, and payable to the Treasurer, in advance," and to substitute for the same the following:

Every regular member shall be subject to an annual fee of three ($3.00) dollars, payable to the Treasurer, in advance, on January 1st of each year. New members elected after the first quarter of the year shall, upon their election, pay only the pro rata portion of the annual dues for that year. All members shall, upon payment of annual dues, receive a membership card signed by the Treasurer, which shall entitle them to free admission to the lectures given under the auspices of the Academy.

One hundred and sixteen persons were elected to regular membership.

The Standing Committees were announced.

An official seal for the Academy was adopted.

H. E. C. Ditzen read a paper on "Life and Habits of the Starfish."

March 30, 1896—Regular Meeting.

The Lecture Committee reported the successful conclusion of the course.

Twenty-nine persons were elected to regular membership.

A. F. Ewers read a paper on "The Vegetable Cell," illustrated by lantern slides.

April 27, 1906—Regular Meeting.

J. A. Udden, of Augustana College, Rock Island, gave a lecture on "Some Evidences of Glaciation."

The following papers were presented for publication and referred to the Publication Committee:

"The Birds of Iowa," by Rudolph Martin Anderson, of the State University of Iowa. [Published in the Proceedings, Vol. XI.]

"The Protozoa of Iowa," by Charles Howard Edmondson, of the State University of Iowa. [Published in the Proceedings, Vol. XI.]

May 25, 1906—Regular Meeting.

Routine business and discussion.

May 29, 1906—Trustees' Meeting.

Voted to expend a sum not to exceed $200 for binding books.

Voted to employ a taxidermist, as needed, to care for the collection of mounted birds.

June 29, 1906—Regular Meeting.

Routine business and discussion.

July 27, 1906—Regular Meeting.

Voted to send the California Academy of Sciences a set of the Academy Proceedings to replace those lost in the San Francisco fire.

August 31, 1906—Regular Meeting.

Demonstration of the Opaque Projector, an instrument for projecting images upon a screen by means of reflected light.

September 28, 1906—Regular Meeting.

Edward K. Putnam gave an account of the California earthquake, illustrated by photographs.

October 26, 1906—Regular Meeting.

Curator Paarmann reported upon the opening of a mound [No. 65]* near Albany, Ill., by a party of Academy members. This mound yielded some important additions to the Academy's museum. The objects found were shown, and views showing the progress of the work were thrown upon a screen. Discussion.

November 5, 1906—Trustees' Meeting.

Edward K. Putnam, Trustee of the Putnam Memorial Fund for the benefit of the Academy, explained the present condition of the fund. This was followed by a general discussion of the present needs of the Academy, and also of the objects to be sought for in its future development.

A committee was appointed to recommend changes in the Constitution.

November 30, 1906—Trustees' Meeting.

The Executive Committee reported on the most pressing needs of the Academy.

The Committee on Constitution presented a revision of the Articles of Incorporation and Constitution and recommended its adoption.

Voted that the Executive Committee be instructed to carry out certain recommendations to lessen the danger of fire in the Academy buildings.

Voted to grant the application of Ludwig Guldner, J. H. Paarmann, C. F. Kemmerer, T. W. Kemmerer, H. E. C. Ditzen, C. Meyer, Jr., C. A. Kellogg, Jr., O. H. Lowary, and A. F. Ewers, to form a Section of the Academy to stimulate individual research.

November 30, 1906—Regular Meeting.

Prof. C. C. Nutting, of the University of Iowa, addressed the Academy on "The Function of the Provincial Museum." [Published in the Proceedings, Vol. X.]

December 28, 1906—Trustees' Meeting.

Voted to recommend to the Academy the adoption of the revised Articles of Incorporation and Constitution.

* Hereafter, Albany mounds will be designated by the numbers given them in the plat made by W. H. Kimball, 1907.

Voted to utilize Science Hall for museum purposes, the alterations to be made as soon as finances will permit. A. F. Ewers, E. K. Putnam, and A. F. Cutter were appointed a committee for this purpose with power to act.

December 28, 1906—Regular Meeting.

The Articles of Incorporation and Constitution were amended in accordance with the recommendations of the Board of Trustees. [Printed at end of this volume.]

A. W. Elmer read a paper on "Iron Found in the Albany Mounds."

The Curator reported on the finds in the second mound [No. 70] opened at Albany.

January 8, 1907—Annual Meeting.

The President, C. A. Ficke, in the chair.

Reports of the officers and committees were read.

Officers for the year 1907 were elected.

REPORT OF THE CORRESPONDING SECRETARY FOR 1906.

The report of Miss S. G. F. Sheldon, the Corresponding Secretary, gave details of the correspondence during the year, and also of matters connected with the exchange of publications.

REPORT OF THE TREASURER FOR 1906.

The report of Miss Elizabeth D. Putnam, the Treasurer, follows:

RECEIPTS.

Dues	$ 628.00	
Subscriptions	544.25	
Putnam Memorial Fund	110.00	
Interest	100.56	
Lectures	544 10	
Science Hall	100.00	
Rebate, account of water	1.96	
Door receipts	22.48	
Sale of publications	26.15	
Cash balance as per last report	88.69	$2,166.19

EXPENSES.

Salary of Curator	$ 600.00	
Salary of Janitor	314.00	
Fuel	151.48	
Light	15.90	
Water	8.25	
Building repairs and expenses	16.91	
Office supplies and expense	47.07	
Printing	53.50	
Addition to library	10.40	
Library expense	1.65	
Addition to museum	9.00	
Museum expense	50.58	
Insurance	90.00	
Freight and expressage	12.74	
Mound-exploring expense	135.10	
Lecture expenses	350.70	
Electric light fixtures	197.65	
Typewriter	78.50	
Balance on hand	22.76	$2,166.19

PUBLICATION ACCOUNT—RECEIPTS.

From Putnam Memorial Fund	$1,000.00	
From interest on bank deposit	12.56	
From refund, typographical changes	23.00	
Balance on hand January, 1906	740.07	$1,775.63

EXPENSES.

Printing	$1,376.65	
Engraving	298.90	
Binding	67.00	
Miscellaneous	29.60	
Balance on hand	3.48	$1,775.63

REPORT OF THE PUBLICATION COMMITTEE FOR 1906.

The Publication Committee reported that owing to many unforeseen delays Volume X had not been completed, but would be in a few months. Two papers had been accepted and printed in Volume XI.

REPORT OF THE CURATOR FOR 1906.

The first part of the report of J. H. Paarmann, the Curator, treats of the purpose of museums, outline of the past year's work, suggestions for the work of the coming year, the need of a larger staff for carrying on the work of the museum, library, publications, etc., and the need of additional floor space, cases, and accessories, for the museum. The report continues:

An exhibit and a study series of the mussel shells from this locality has been prepared. It contains every species of mussel found in the vicinity of Davenport. A pearl and pearl shell exhibit has been arranged; also one to illustrate the pearl button industry of the Mississippi Valley, this latter collection being the gift of J. F. Boepple. These exhibits, together with the remainder of our shell collections, have been installed in a fine new case designed especially for the purpose. A catalog of the shell collection has been prepared on cards. About 6,000 library cards were used for this catalog. The entire work of preparing this exhibit was done by Miss Sheldon, to whom the Academy is also indebted for the case and the card catalog and other supplies used in preparing the specimens for exhibition or study. Miss Sheldon has also classified and stored, so as to be easily accessible for study or exchange, our large supply of duplicate specimens of land and river shells from this and other localities.

LECTURES TO SCHOOL CHILDREN.

On beginning my work as teacher of science in the public schools of this city I had planned that the teachers of the various schools should bring their classes to the Academy during the spring and fall to study such subjects as could be illustrated with objects from our museum, and that I give talks at the school buildings during the winter months. Had it been practicable to carry out this idea, as first contemplated, it would have taken up much less of the curator's time than under the present system. But the teachers of the outlying schools felt that it would be a hardship to bring classes, especially those of primary or intermediate grades, for such great distances. Under the present system, therefore, I visit each school once every three weeks during the fall and winter, giving from four to eight (usually five) lectures at each school during a single forenoon. My plan is to go from room to room, taking with me specimens from our museum for illustrating the lesson. In most of the schools I take the rooms two and two and am thus enabled to talk to from 250 to 400 pupils per day. During the months of May and June of the present year the Ninth Grades from the different schools were taken on excursions to the Government Island, one school at a time, for the purpose of studying the birds and their habits, and the Seventh and Eighth Grades were given lectures at Science Hall on our common wild flowers. These lectures were illustrated with stereopticon slides. After the lectures the classes were taken through the museum by their teachers. I believe the children are taking interest in this work, and it seems that the teachers and principals are willing that it should be continued. Yet I feel that there is much work accumulating at the Academy which is now neglected on account of want of time. It would not be well for the Academy to give up the lectures in the schools, nor can we longer postpone the work that should be done at the museum. It might be advisable to confer with the School Board regarding the employment of an assistant who would continue the lectures at the schools, thus allowing me once more to give full time to the Academy.

The Academy can be made still more helpful to the schools through the

preparation of loan collections, accompanied by study outlines, for use at the various schools. By coöperation with the School Board a series of illustrated lectures for children might be arranged, these to be given by local persons, admission being free. These free lectures to children are meeting with much favor in the museums of our larger cities.

Summary.

1.—Each school visited once in three weeks (forenoons).	
2.—Number of lectures daily	5
3.—Number of lectures at schools during year	820
4.—Lectures to children, Science Hall, illustrated with lantern	4
5.—Excursions to Government Island for bird study	13
6.—Number of classes that visited the museum	26

EXPLORATIONS.

During the summer of 1906 the attention of the Academy was called to the groups of mounds in Whiteside county, Ill., not far from the town of Albany. After obtaining permission from the owners of the land on which the mounds are located, a number of expeditions were sent out. Two of the larger mounds were explored, resulting in some very interesting finds. A survey of the region is to be made during the present winter. After the material has been worked over a more complete report will be prepared.

DONATIONS.

The museum has increased rapidly in size and usefulness during the past five years. All this is due to the generosity of our numerous patrons and their pride in maintaining a good local museum. Very seldom is the Academy called upon to purchase a specimen for its collections. Almost our entire museum has grown up through donations. It is gratifying to know that a large percentage of the specimens in the Natural History department are brought in by children.

ACCESSIONS TO MUSEUM.

Geology	3	specimens
Paleontology	several hundred	"
Botany	1	"
Zoölogy	20	"
History	3	"
American Archæology	240	"
American Ethnography	102	"
Miscellaneous	10	"

VISITORS TO MUSEUM.

(See Appendix.)

The plan of opening the museum on the first Sunday of each month was begun in November, 1903, and is still continued.

ANNUAL ADDRESS OF THE PRESIDENT.

Members of the Academy, Ladies and Gentlemen—The year for which you honored me with the presidency of the Academy comes to a close with the present annual meeting. Glancing back over this year I am both gratified and impressed with the activity manifested by the association during that period—an activity which marks the year 1906 as a memorable one in the history of the institution.

The Academy during that year added 169 new names to its membership; it completed the publication of one volume of its proceedings and started upon the publication of another; it held many interesting and well attended meetings; it provided a regular course of lectures by noted scientists and

also a number of lectures by its own members; it continued its good work in the public schools; it attracted an increased number of visitors to its museum; it explored a number of mounds; it organized among its members a section for study and research; it rearranged and relabeled many of the collections of its museum; it added many new specimens to these collections and many volumes to its library; and it revised its constitution and by-laws to make them better serve its needs in its ambitious and far-reaching plans for the future.

Let me speak more in detail of the work of the Academy. During the year Volume X of its proceedings was practically completed. This volume as a whole will soon be ready for distribution. Besides a memoir to Mrs. Mary L. D. Putnam, it contains a biography of William Clement Putnam, and valuable papers by Prof. David Starr Jordan, Dr. Alfred Seale, Prof. Samuel Calvin, Prof. L. H. Pammel, Prof. T. D. A. Cockerell, Baron C. R. Osten Sacken, Prof. Walter J. Fewkes, Prof. Thomas H. Macbride, and Prof. C. C. Nutting. It is expected that Volume XI will be completed before the close of the present year. One of its parts, a valuable paper upon "The Protozoa of Iowa," by Charles H. Edmondson, is already out. In the publication of this and all future volumes the Academy changes the manner of publication of its proceedings. It issues the separate papers in pamphlet form and distributes them as soon as printed, leaving it to those who desire to keep the files intact to bind each volume when all the parts are complete. It is these publications of the Academy that carry its name and fame to all corners of the globe. It is these too that bring us in exchange valuable additions to our library.

During the year the Academy gave its usual annual course of lectures. This course proved to be one of the most successful in the history of the Academy. The lecturers were all authorities upon the subjects upon which they spoke, and several of them were men of international renown. The list included Prof. Samuel Calvin, Dr. Otto Nordenskjöld, Dr. Duren J. H. Ward, Prof. C. C. Nutting, Dr. John P. Peters, and Prof. Thomas H. Macbride. The attendance was uniformly large. Additional lectures were delivered at the monthly meetings of the association by H. E. C. Ditzen, A. F. Ewers, Prof. J. A. Udden, J. H. Paarmann, Prof. C. C. Nutting, and Dr. A. W. Elmer, all members of the Academy. These lectures, too, were well attended. Lectures by members will continue to be the feature of the monthly meetings of the Academy. Of this winter course of lectures, those by Prof. Charles H. Weller, of the University of Iowa, and Prof. R. G. Thwaites, Secretary of the Wisconsin Historical Society, have been already delivered. The remaining ones by Prof. Arthur P. Farwell, Prof. Frank G. Chapman, Prof. William Trelease, Prof. Samuel Calvin, Prof. T. H. Macbride, and Prof. Arthur Fairbanks will be delivered during January and February. Probably several more lectures will be added to this course. All these are free to members. The rule admitting its members free to all its lectures was adopted by the Academy in February. It met with much favor and continues in force.

The close and cordial relations which for years have existed between the Academy and the public schools were still further strengthened during the past year. The Academy's curator, J. H. Paarmann, delivered 820 lectures before classes from these schools in their respective classrooms during the school year. He addressed between 250 and 400 pupils daily, and used specimens brought from the Academy's museum to illustrate all his lectures. In addition, he delivered four illustrated lectures before classes from these schools, at Science Hall, escorted thirteen excursions to Government Island for bird study, and addressed many classes from the schools at the Academy, where with the aid of specimens from the museum he greatly increased the interest of the pupils in nature studies. Through the pupils whose interest in the Academy was thus awakened, their parents also became visitors and friends of that institution.

In order that the Academy may still further enhance its value as an educational factor, it should offer to hold its future regular lectures in the auditorium of the new high school and admit students of that school free to these lectures under such reasonable restrictions as its trustees may see fit to impose. Negotiations with this end in view should be opened with the Davenport School Board as soon as the new high school building is completed.

The cordial relations which have also long existed between the Academy and all other educational institutions of the three cities continue unchanged. Pupils from these institutions make free use of our museum and are at all times heartily welcome.

During recent years the Academy, through gifts and in exchange for its own publications, has received many additions to its library. The most important of the gifts were the library of Griswold College, presented by its trustees, and that of D. S. Sheldon, which, with many additional volumes, was presented by Miss Sarah Foote Sheldon. These gifts are highly appreciated. The books and pamphlets of our library now number 48,553. It is one of the most valuable scientific libraries west of Chicago.

During recent years the Academy, through gifts, also received many accessions to its museum. The most important of these were a large collection of baskets of Indian make and a large collection of stuffed native birds presented by W. C. Putnam shortly before his death; a large and valuable collection of animal heads and horns presented by Dr. D. D. Palmer; a collection of natural history specimens presented by Mrs. Anna Wuestenberg; a collection of marine invertebrates presented by Webb Ballord, and a collection illustrating the manufacture of pearl buttons presented by J. F. Boepple. Besides these there were received many welcome gifts of small collections and single specimens from other friends of the institution. To all of these donors the Academy feels itself deeply indebted.

Within the last few days the Academy has also received by gift a collection of Indian relics consisting of 1,200 specimens found in this vicinity. This collection was purchased from its owner and presented to the Academy by its president. Charles J. Beenck, who devoted twenty-five years to making this large and valuable collection of local Indian relics, and who either found these specimens himself or obtained them from those who found them, has rendered this community services for which great credit is due him. I suggest that he be presented with a life membership in the Academy in recognition of these services.

During the past year many of the collections of the Academy's museum were rearranged and supplied with descriptive labels that convey the maximum information regarding the specimens. This has added much to the scientific value of these collections. It has made them of greater service for study purposes and of greater interest to the general public. Special thanks are due to Miss Sarah Foote Sheldon and our curator for this work. The decision of the Academy, recently reached, to use Science Hall for museum purposes after the close of the present course of lectures, is a most commendable one. This will provide the much needed space for collections which heretofore could not be properly displayed. There is great need, however, of additional cases if these collections are to be displayed at their best. I hope to see these provided before the close of another year.

It is the aim of the present officials of the Academy to develop its museum on broad lines. While each museum should have its special features, as has ours in its collection of mound-builders' relics, and should also have a notable collection in some line and aim at completeness for this, that museum, nevertheless, will be of greatest benefit to the general public in which all lines are represented. When, therefore, the Academy shall once possess a spacious new museum building I hope to see not only rooms for anthropological, archæological, geological and botanical collections, but also rooms for historical and art collections.

The number of visitors at the museum during the last year exceeded 6,000. This large attendance is most gratifying proof of the growing interest in the Academy's work. It is also proof of the wisdom of opening the museum to the public on the afternoon of the first Sunday of each month, and of granting free admission at such time as well as on certain week days.

The financial condition of the Academy continues most satisfactory. At its last annual meeting the association for the first time in its history found itself free from debt. It has remained so since and enters upon the new year with a surplus. However, its needs are many and it is hoped that the citizens of Davenport who, during the last thirty years through their liberal contributions made the Academy what it is, will continue to exercise toward it their usual liberality.

Last autumn the Academy resumed its old-time activity in search of light on the ever puzzling question, Who were the mysterious people who in prehistoric times built the myriads of mounds which are found along the Mississippi and its tributaries? The results of its explorations of mounds at Albany, Illinois, were magical. Not only were its discoveries of great scientific interest, but the Academy through these again became as much the center of interest of scientists the world over as it was when in earlier years it was active in exploring the Toolesboro and Cook Farm groups of mounds. Its fame is again spreading to all points of the compass. Given the exclusive privilege by the owners of the Albany group of mounds to explore these, the Academy confidently looks forward to further interesting discoveries that will doubtless throw additional light on the question whether their builders were the ancestors of the present day American Indians, or a race now extinct, or a people now represented only by descendants dwelling in regions remote from the early homes of their ancestors in the valley of the Mississippi.

During the last year a section for study and research was organized within the Academy. This is the most encouraging of all the signs of that institution's reawakening. Here at last is a united effort to aid the Academy in serving its highest purpose by making it the center of active scientific work. From the ranks of this section will come the men to whom in future years the Academy will entrust its highest interests. From it may also rise some future Agassiz or Audubon.

The most important matter affecting the Academy I have reserved for the last. It refers to William Clement Putnam's princely bequest. Under his will and as a memorial to his parents, Mr. Putnam left practically his entire fortune in trust for the benefit of the Davenport Academy of Sciences, to be used by it for the increase and diffusion of knowledge. Seldom have the savings of a lifetime been consecrated to nobler purposes than were those of Mr. Putnam when they were thus made subservient to science, art, and education. Generations of grateful people will carry the name of William Clement Putnam, philanthropist, down through the centuries until the end of time. Let me here once more record our deep sense not only of Mr. Putnam's noble gift, but also of the confidence he reposed in the Academy when he chose it as the instrument for carrying out his high purposes.

Through this bequest the year 1906 is marked as that of the beginning of the renaissance of this institution. Henceforth its ambition will soar to heights never dreamed of by its founders. Let us bear in mind, however, that only that is destined to endure which is carefully planned and is made to rest on solid foundations. It is meet, therefore, that we proceed with the deliberation due the important work in hand. But when once the Academy's carefully-to-be-considered plans for the future shall have been fully matured, its progress in placing itself in the front rank of America's scientific institutions will be by leaps and bounds.

Doubtless you would be glad to know how long it will be until the corner-stone for the new fire-proof museum building, for which there is great

need, and for the erection of which Mr. Putnam provides in his will, can be laid. We hope it will not be many years. Mr. Putnam, with the object of making his estate further in the greatest measure the purposes for which it was given, left specific instructions regarding its management. But the trustees charged with carrying out these instructions are also given certain discretionary powers. Inasmuch as these trustees are themselves most warmly attached to the institution which was so near the heart of Mr. Putnam, the members of the Academy may well feel that its interests are in the best of hands. They may rest assured that the discretionary powers will be wisely exercised, and that funds for the erection of the new museum building, and for the development of the institution in compliance with the wishes of Mr. Putnam, will be made available as speedily as the best interests of the Academy will permit.

Meanwhile, officers, trustees and members of the Academy, it behooves us to relax none of our efforts to advance, and to guard jealously, the interests of this institution while they are entrusted to our care.

APPENDIX.

ACCESSIONS TO THE MUSEUM.

1904-1906.

All accessions are by gift. Donors are citizens of Davenport unless otherwise noted.

GEOLOGY.

Baker, Charles J.	Specimens of wolframite, antimony, and uranium from the Black Hills.
Collister, Clayton	2 fossil crinoids, Quarry, Iowa.
Edwards, Allan	Fossil, Montana.
Gronen, W. O.	Copper ore, petrified wood.
Hammatt, E. S.	Collection of fossils.
Harrison, E. R.	Minerals, Jackson county, Mont.
Petersen, A	Ammonite.
Petersberger, Isaac	57 specimens of rocks.
Putnam, Miss E. D.	Trilobites.
Putnam, W. C.	Ichthyosaurus, ammonites sp., Charmouth, Dorset, England; 10 specimens of native copper, 2 of iron ore, 1 of lead ore, Michigan.
Rumsey, Byron	Geological specimen.
Smith, Mrs. S. F.	Minerals, Colorado.
Wuestenberg, Mrs. Anna	40 specimens of rocks.

ZOÖLOGY AND BOTANY.

Auerochs, May	Wilson's Thrush.
Ballord, E. S.	2 skunk skins.
Bechtel, Harold	Rabbit, young.
Berwald, Walter	Little Green Heron, Pleasant Valley, Iowa.
Blair, Burdette	Cedar Waxwing.
Brouse, Charles, and Van Patten, Herbert	Muskrat.
Brown, Mabel A.	Golden-crowned Kinglet.
Burns, Mrs. Mattie	Hornet's nest.

Burrows, Mrs. P. T............Snowy Owl, mounted.
Busch, Ralph..................Gray-cheeked Thrush, Rose-breasted Grosbeak ♀, Davenport.
Elmer, Dr. A. W...............Myrtle Warbler ♀, Davenport.
Ficke, C. A...................54 birds, mounted and labelled, Japan; 2 Leaf Insects, East Indies; 46 specimens of coral, Singapore.
Goodwin, Mabel.... ....Wilson's Thrush, Davenport.
Harrison, C. E............. ..Centipede, nest of Trap-door Spider, horn of Swamp Ox, India, used as a container for civet.
Hilmers, Carl.................Sora Rail, Davenport.
Houdek, Mrs. R...............Shell containing 3 Mississippi River pearls.
Hubbell, Lawrence............Fox Sparrow, Davenport.
King, J. D...................Deep sea shells.
Koehler, Mrs. Henry...........Stem and beans of coffee tree.
Kunz, Ben....................Woodchuck, Davenport.
McCune, C. A.................Ring-necked Pheasant, Oregon.
Mandeville, Miss A. L.........Wood Duck; Willow Ptarmigan, Colorado; group of Bobwhite, pair of Bobwhite, pair of Woodcock, Baltimore Oriole, Egret, Flying Squirrel, Scott county, Iowa; Valley Partridge, California.
Mengel, William..............Black-crowned Night Heron.
Muxfeldt, Henry..............Cardinal, Ont.; Lamprey eel, St. Lawrence River.
Nagel, R.....................Rabbit, abnormal.
Nelson, George................40 sets of bird's eggs.
Palmer, D. D. and B. J.........42 mounted mammal heads; 147 mounted pairs of horns; 5 Rhinoceros horns; 1 pair Giraffe horns; Walrus skull; Walrus tusk; Six-banded Armadillo, mounted; Squirrel, mounted; Wapiti; whalebone; two saws of Sawfish; Mastodon tusk, Alaska; Babirussa skull, Borneo; Lobster, mounted; Giant Clam, East Indies; 2 Narwhal tusks.
Pammel, Prof. L. H., Ames, Iowa, 50 common weeds of Iowa, mounted and labelled; 32 specimens of wood (sections of tree trunks), Iowa.
Parry, Mrs. C. C...............Ferns.
Peto, F. E.................... Snake, in alcohol, Florida.
Ploehn, Camilla...............Oven Bird, Davenport.
Priester, Adolph...............Collection of insects, mostly butterflies.
Putnam, E. K.................Botanical specimens, California; pine cones from the Sierra Nevada.
Putnam, Mrs. E. K............Trout, mounted, Sweden.
Putnam, W. C.................Kallima Butterfly, India; Purple Heron, Europe.
Raabe, John...................Yellow-bellied Sapsucker, Davenport.
Schlessmann, Barbara.........Long-billed Marsh Wren, Davenport.
School No. 1..................Mourning Warbler ♀, Davenport.
School No. 4.................Nashville Warbler ♀, Sora Rail, Davenport.
School No. 10................ Nashville Warbler ♀, Davenport.
Spring, Fred..................Cape May Warbler, Davenport.
Stafford, Charles......... ....Ovenbird, White-throated Sparrow, Davenport.
Truckenmiller, Charles...... Bay-breasted Warbler, Yellow Warbler, Davenport.
True, Edgar...................Golden-crowned Kinglet ♂, Davenport.

Valerius, Oscar............. .Flying Squirrel, Davenport.
Voelkers, Lawrence ....Golden-crowned Kinglet ♀, Davenport.
Vollmer, Harry ....Canadian Warbler, Davenport.
White Yard, The..............Specimens of Curly White Pine and Curly Yellow Pine lumber.
Wuestenberg, Mrs. Anna......20 specimens of coral, 5 Starfish, 206 shells, alligator, young, mounted.
Wundram, Oscar.............Golden-crowned Kinglet ♀, Davenport.

ANTHROPOLOGY.

Bronner, Miss Anna.......... Stone gorget, Erie county, New York.
Fisher, Francis J., Chicago, Ill., Mummified hawk from the tombs of Abydos, Egypt.
Grabbe, Charles...............157 arrow and spear heads.
Haase, William................8 stone implements from near Fox Lake, Minnesota.
Harrison, C. E......... ... .. Discoidal stone, Carrollton, Ky.
Kempker, Rev. J. F. ....Arrowheads.
Koehler, Mrs. Henry..........Tapa cloth.
Moore, Clarence B............62 shell implements, 10 perforated shells, 34 wrought shells, Marco, Florida.
Muenchow, J. F..............Copper ax.
Petersberger, Isaac .... Spearhead.
Plummer, Edwin V...........Zulu war club, Africa.
Putnam, Miss E. D............5 pieces of Mexican pottery, modern; Sulu garment; Eskimo throwing stick; sample of Navajo weaving.
Putnam, E. K................ 12 specimens of the work of the Washoe and Paiute Indians of Nevada; stone ax.
Putnam, G. R.................Native straw hats, Philippines.
Putnam, W. C.................102 Indian baskets.
Tucker, Harvey, Albany, Ill...Shell vessel and potsherds from mound No. 71 at Albany, Ill.
Wuestenberg, Mrs. Anna......36 stone axes, 2 pestles, chipped-stone hoe, 9 articles of polished stone, 6 sets shell beads, 275 arrow and spear heads, 6 flint perforators.

MISCELLANEOUS.

Boepple, J. F..................Exhibit to illustrate pearl button industry.
Burmeister, Walter............Candlestick, 150 years old; pocket-knife, 200 years old; seal, old-fashioned, Germany.
Duncan, Joseph...............Chest of carpenters' tools.
Harrison, C. E....... ...."Panorama of Davenport in the year 1872," photograph of oil paintings of Fort Armstrong, Rock Island; 4 other historical relics.
Naeckel & Sons ....Exhibit to illustrate process of making white lead.
Mueller, A. O.................Burmese prayer-book; Chinese back-scratcher; model boat of birch bark; historical specimens, Michigan.
Rindler, Dr. A............... Japanese muscle roller (for massage).
Sheldon, Miss S. G. F.........Cases for exhibiting and storing shells; 5 dozen frames, with glass, for mounting butterflies for study.
Spink, Mrs. Henry............Chinese hat; Night lamp and food warmer, England.
Whitaker, Charles............Carding combs for cotton, pair of holsters.
Wuestenberg, Mrs. Anna ......20 miscellaneous articles.

VISITORS TO THE MUSEUM.

The museum is open to the public from 1 to 5 P. M. every week day and from 1:30 to 5 P. M. on the first Sunday in each month.

Year.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1904	250	450	1119	1262	722	660	138	148	1008	910	486	137	7290
1905	305	427	1440	1329	1058	1589	320	480	580	490	442	387	8847
1906	446	468	538	515	175	1420	230	180	190	287	592	378	5419

The figures given are taken from the visitors' register and, as many visitors do not register their names, these figures are only approximately correct. This is especially true for 1906, when the attendance was probably larger than ever.

ACCESSIONS TO LIBRARY, 1904-1906.

BY GIFT

Bowman, Dr. E. S.	1
Burns, Mrs. M	4
Decker, Miss Frances S	20
Democrat Co.	285
Durfee, Mrs	2
Eads, L. T.	2
Gould, Miss Ellen	1
Kempker, Rev. J. F.	2
Leader Co	45
Plummer, C. G	3
Preston, Dr. C. H	12
Putnam, Miss E. D.	11
Sanders, Miss J. E	12
Sheldon, Miss S. G. F.	13
Whitaker, Charles	2
Wuestenberg, Mrs. Anna	21
Total books	436

By purchase .... 40 books
By exchange .... 3,761 accessions (incl. pamphlets)

LECTURES, 1904-1907.

LECTURE COURSE, SEASON 1903-1904.

January 4, 1904. Dr. L. O. Howard, Washington, D. C., "Some Interesting Features of Insect Life."
January 11, 1904. Prof. C. C. Nutting, University of Iowa, "Protective Coloration Among Animals."
January 18, 1904. Prof. Thomas H. Macbride, University of Iowa, "Alamogordo— a Problem of the Desert."
January 25, 1904. Prof. Charles S. Magowan, University of Iowa, "Sanitary Engineering."
February 1, 1904. Prof. Bohumil Shimek, University of Iowa, "Man in the Tropics."
February 8, 1904. Prof. A. A. Veblen, University of Iowa, "Ancient Ship Building in Northern Europe."
February 15, 1904. Prof. Samuel Calvin, University of Iowa, "The Geology and Scenery of the Pipestone Region."

SEASON 1904-1905.

October 31, 1904. Prof. Thomas H. Macbride, "The Plant Responsive to Human Preference."
November 7, 1904. S. P. Verner, St. Louis, Mo., "Adventures and Studies Among the African Pigmies."
November 14, 1904. Prof. Bohumil Shimek, University of Iowa, "The Use and Abuse of Trees."
November 21, 1904. Prof. C. C. Nutting, University of Iowa, "The Alaskan Fur Seal."
November 28, 1904. Prof. Samuel Calvin, University of Iowa, "A Geological Excursion Among the Rockies of Colorado."
December 5, 1904. Prof. Laenas G. Weld, University of Iowa, "Life History of a Star."

ADDITIONAL LECTURES.

January 19, 1905. Charles S. Lummis, Los Angeles, California, "The Primitive Songs of the Southwest," given with the coöperation of the Archæological Institute of America.
February 12, 1905. W J McGee, Washington, D. C., "Fire, Knife and the Wheel."
November 24, 1905. C. A. Ficke, Davenport, "Japan."

SEASON 1905-1906.

January 15, 1906. Prof. Samuel Calvin, University of Iowa, "Vulcanism and Related Phenomena in the Yellowstone National Park."
January 26, 1906. Dr. Otto Nordenskjöld, Sweden, "Two Years Amongs the Ice of the South Pole."
February 5, 1906. Dr. Duren J. H. Ward, Iowa City, Iowa, "Our Iowa Indians, the Meskwakis of Tama County."
February 12, 1906. Prof. C. C. Nutting, University of Iowa, "Marine Investigation on the Coast of Southern California."
February 19, 1906. Dr. John P. Peters, New York, "The Pennsylvania Expeditions to Babylon."
February 26, 1906. Prof. Thomas H. Macbride, University of Iowa, "Luther Burbank and His Garden."

ADDITIONAL LECTURES.

March 15, 1906. Dr. Alfred M. Tozzer, Harvard University, "Central American Archæology," given with the coöperation of the Archæological Institute of America.
December, 1906. Prof. C. H. Weller, University of Iowa, "Here and There in Greece," given with the coöperation of the Archæological Institute of America.
November 30, 1906. Prof. C. C. Nutting, University of Iowa, "The Function of the Provincial Museum."

LIST OF PRESIDENTS

OF THE

DAVENPORT ACADEMY OF SCIENCES.

D. S. Sheldon..........	December 14, 1867 to	October 9, 1868.
C. C. Parry	October 9, 1868, to............	January 9, 1875.
E. H. Hazen	January 9, 1875, to............	January 5, 1876.
W. H. Barris.	January 5, 1876, to.	January 3, 1877.
S. S. Hunting.	January 3, 1877, to............	January 25, 1878.
R. J. Farquharson.	January 25, 1878, to...........	January 1, 1879.
Mrs. Mary L. D. Putnam.	January 1, 1879, to...........	January 7, 1880.
W. H. Pratt.	January 7, 1880, to............	January 5, 1881.
J. Duncan Putnam	January 5, 1881, to his death...	December 10, 1881.
C. H. Preston	January 4, 1882, to...........	January 3, 1883.
E. P. Lynch	January 3, 1883, to...........	January 2, 1884.
H. C. Fulton..........	January 2, 1884, to...........	January 7, 1885.
C. E. Putnam	January 7, 1885, to...........	January 26, 1887.
C. E. Harrison	January 26, 1887, to.........	January 16, 1889.
Miss Jennie McCowen .	January 16, 1889, to...........	January 7, 1891.
James Thompson	January 7, 1891, to his death ..	February 11, 1892.
W. L. Allen.	February 11, 1892, to	January 2, 1895.
E. S. Hammatt..........	January 2, 1895, to............	January 18, 1899.
Charles Francis	January 18, 1899, to.	January 5, 1900.
Mrs. Mary L. D. Putnam.	January 5, 1900, to her death...	February 20, 1903.
A. W. Elmer	February 20, 1903, to	January 10, 1906.
C. A. Ficke	January 10, 1906, to	....

ELECTIONS TO MEMBERSHIP.

January 29, 1904—December 31, 1906.

HONORARY MEMBERS.

Gifford Pinchot, Washington, D. C	January, 1905
Charles F. Lummis, Los Angeles, California	January, 1905
Otto Nordenskjöld, Gothenburg, Sweden	January, 1906

CORRESPONDING MEMBERS.

F. J. Becker, Iowa City, Iowa	March, 1904
Harlan I. Smith, New York, N. Y	September, 1904
Joseph Zawodny, Prague, Austria	December, 1905
Cleveland Abbe, Washington, D. C	May, 1906
E. L. Lefebure, Cedar Rapids, Iowa	September, 1906
S. A. Maxwell, Morrison, Illinois	November, 1906

REGULAR MEMBERS.

(Residence Davenport, unless otherwise stated.)

Ditzen, Henry E. C	January,	1904
Brugman, John J	February,	1904
Lau, Charles W	"	"
Udden, J. A., Jr., Rock Island, Ill,	September	"
Cable, Mrs. Ben T., Rock Island, Ill	January,	1905
Davison, Donald	"	"
Decker, Miss F. S	February,	"
Ells, Miss Louise	"	"
Lambach, Fred H	"	"
Glueck, Fred, Jr.	December,	"
Beenck, J. C	January,	1906
Atkinson, Arthur	February,	"
Atkinson, Mrs. Arthur	"	"
Baldwin, J. R	"	"
Banning, G. W	"	"
Birchard, C. E	"	"
Block, Louis	"	"
Bräunlich, Henry	"	"
Burch, Ira C	"	"
Burrows, P. T	"	"
Burrows, Mrs. P. T.	"	"
Bushnell, Horace T.	"	"
Calkins, J. E	"	"
Campbell, L. R.	"	"
Carstens, L. P.	"	"
Cole, F. L.	"	"
Collins, Edward	"	"
Cram, Ralph W	"	"
Crouch, Fred A.	"	"
Crouch, Mrs. Fred A	"	"
Davis, J. J.	"	"
Decker, G. E.	"	"
Dilworth, W.H., Rock Island, Ill	"	"
Donahue, J. P	"	"
Donahue, Mrs. J. P	February,	1906
Donald, Gustav	"	"
Donegan, M. F.	"	"
Downer, H. E	"	"
Dueser, F. H	"	"
Evans, S. J	"	"
Evans, T. J	"	"
Farrand, Willis	"	"
Ficke, E. O	"	"
Ficke, G. H	"	"
Ficke, Miss Helen.	"	"
Ficke, R. C	"	"
Fidlar, W. F	"	"
Fisher, L. M	"	"
Friedholdt, B. C.	"	"
Gehrmann, W. H.	"	"
Grilk, Charles.	"	"
Guldner, Ludwig F.	"	"
Haase, William	"	"
Haase, Mrs. William	"	"
Haight, W. K	"	"
Hall, J. C	"	"
Harkness, G. F.	"	"
Hartz, H. W	"	"
Hartz, Theo	"	"
Hayward, A. W	"	"
Hecht, J. L	"	"
Hetzel, C. C	"	"
Hornby, J. A	"	"
Huber, C. S	"	"
Humphrey, W. W	"	"
Jacobs, J. H	"	"
Jennings, W. H.	"	"
Kaufmann, Ed	"	"
Kellogg, C.	"	"
Kemmerer, C. T	"	"
Kemmerer, T. W	"	"

Koehler, Herbert O...	February,	1906
Krohn, Hugo	"	"
Kulp, Ray R.........	"	"
Ladenberger, Otto L..	"	"
Lischer, Fred A......	"	"
Lischer, Oscar	"	"
Lowary, O. H	"	"
McCandless, C. R....	"	"
McCullough, W. J....	"	"
McIntyre, C. C.......	"	"
Marks, M. L....... .	"	"
Martin, Wellington H.	"	"
Meyer, C., Jr.	"	"
Meyer, Edward U....	"	"
Middleton, George...	"	"
Nagel, J. J...........	"	"
Nagy, B. A...........	"	"
Nutting, J. R.........	"	"
Nutting, Mrs. J. R....	"	"
Ochs, Joseph.........	"	"
Otis, E. L............	"	"
Ottesen, Realff.......	"	"
Parsons, Alfred.......	"	"
Petersen, Adolph.....	"	"
Phillips, C. E........	"	"
Pierce, S. W..........	"	"
Porter, J. R..........	"	"
Preston, Charles I....	"	"
Redfield, R. P........	"	"
Richter, August	"	"
Robeson, C. E........	"	"
Rothschild, Moses....	"	"
Rudolf, F. E.........	"	"
Schaefer, J. H........	"	"
Sears, I. H...........	"	"
Sherier, J. W.........	"	"
Smith, Martin H.....	"	"
Stibolt, V. A.........	"	"
Stolle, W. J..........	"	"
Suksdorf, C. L.......	"	"
Temple, S. J..........	"	"
Vincent, C. S.........	"	"
Vollmer, Arthur......	"	"
Vollmer, Karl........	"	"
Wadsworth, Mrs. W. C.	"	"
Waldman, George L..	"	"
Walker, F. J.........	"	"
Wallace, A. S........	"	"
Watzek, Mrs. J. W....	"	"
Weir, W. R..........	"	"
Weir, Mrs. W. R.....	"	"
Wells, W. D..........	"	"
Williams, H. L.......	"	"
Yaggy, L. J..........	"	"
Bowman, E. S.......	March,	1906
Bush, A. G..........	"	"
Carmichael, Joe	"	"
Carstens, H. A......	"	"
Creswell, Miss Grace.	March,	1906
Ditzen, Julius.......	"	"
Dixon, E. W........	"	"
Dixon, Mrs. E. W...	"	"
Giglinger, G	"	"
Goenne, E. C........	"	"
Hartz, B. C., Rock Island, Ill.........	"	"
Hornby, Ben H.	"	"
Kerker, H. W.......	"	"
Kerker, Mrs. H. W..	"	"
Mann, Otto	"	"
Mueller, Alfred C....	"	"
Nabstedt, Henry....	"	"
Nabstedt, J. M......	"	"
Riepe, Adelbert.....	"	"
Rothschild, Mrs. M..	"	"
Silberstein, Emil....	"	"
Silberstein, Louis....	"	"
Silberstein, Martin ..	"	"
Silberstein, Max	"	"
Smith, J. J..........	"	"
Smith, Mrs. J. J	"	"
Whitaker, Byron ..	"	"
Whitaker, Miss Edna	"	"
White, I. S., Rock Island, Ill.........	"	"
Austin, John........	April,	1906
Berger, Fred	"	"
Borcherdt, Miss Olga	"	"
Billstein, Miss Stella.	"	"
Brandt, Miss Clara L.	"	"
Brown, Miss Mary...	"	"
Ells, Louise....	"	"
Engelhardt, R. R....	"	"
Hansen, Martin B...	"	"
Hass, Leon H.......	"	"
Henley, Mrs. Ella V.	"	"
Kersch, Paul, Rock Island, Ill.........	"	"
Koch, G. H.........	"	"
Melville, Mrs. M. E..	"	"
Plummer, Charles G.	"	"
Putnam, Mrs. E. K..	August	1906
Brockmann, John...	November,	"
Godfrey, N. L.......	"	"
Godfrey, Mrs. N. L..	"	"
Eldredge, Miss G. M.	"	"
Harrison, Mrs. F. E.	"	"
McCartney, G. S., Albany, Ill..........	"	"
Silberstein, Mrs. Martin	"	"
Smart, F. L....	"	"
Thomas, Miss Emma	"	"
Wiswell, Mrs. F. J...	"	"
Gast, A. E..........	December,	1906
Green, William	"	"

MEMBERS OF THE DAVENPORT ACADEMY OF SCIENCES.

HONORARY MEMBERS.

Andrews, Launcelot W.	St. Louis, Missouri
*Baird, Spencer F.	Washington, D. C.
Billings, John Shaw	New York City, New York
Calvin, Samuel.	Iowa City, Iowa
*Candolle, Alphonse	Geneva, Switzerland
*Carpenter, W. B.	London, England
*Etheridge, Robert.	South Kensington, England
Fernow, Bernhard E	Ithaca, New York
*Gray, Asa.	Cambridge, Massachusetts
*Hagen, H. A.	Cambridge, Massachusetts
*Henry, Joseph	Washington, D. C.
Holmes, William Henry.	Washington, D. C.
Hooker, Joseph D.	Kew, England
Howard, Leland O	Washington, D. C.
Jordan, David Starr	Stanford University, California
*Kirtland, J. P	Cleveland, Ohio
*LeConte, J. L	Philadelphia, Pennsylvania
Loubat, Duc de	Paris, France
Lummis, Charles F	Los Angeles, California
Macbride, Thomas H	Iowa City, Iowa
Moore, Clarence B.	Philadelphia, Pennsylvania
*Nadaillac, Marquis de	Paris, France
Nordenskjöld, Otto	Gothenburg, Sweden
Nutting, Charles C	Iowa City, Iowa
Osborn, Herbert	Columbus, Ohio
*Osten Sacken, C. R	Heidelberg, Germany
Pinchot, Gifford	Washington, D. C.
Pritchett, Henry S	New York, New York
Putnam, Frederick W	Cambridge, Massachusetts
Starr, Frederick	Chicago, Illinois
*Westwood, J. O	Oxford, England
White, Charles A.	Washington, D. C.

* Deceased.

CORRESPONDING MEMBERS

Abbe, Cleveland	Washington, D. C.
Abbott, Charles C	Trenton, New Jersey
Agassiz, Alexander	Cambridge, Massachusetts
Allen, Joel A	New York, New York
Andreen, Gust. A.	Rock Island, Illinois
Andrews, Edmund	Chicago, Illinois
Arthur, Joseph C	Lafayette, Indiana
Atwood, H. F.	Rochester, New York
Ball, Elmer D.	Logan, Utah
Ballou, W. H	New York, New York
Barcena, Mariano	Mexico, Mexico
Barnes, W. D	Morgan Park, Illinois
Barrois, Charles	Lille, France
Beach, Miss Alice	Urbana, Illinois
Becker, F. J.	Iowa City, Iowa
Bessey, Charles E	Lincoln, Nebraska
Bethune, Charles J. S.	Guelph, Ontario, Canada

Blatchford, E. W	Chicago, Illinois
Boehm, W. M.	
Brandigee, T. S	San Diego, California
Brendel, Emil	Cedar Rapids, Iowa
Brendel, Fred	Peoria, Illinois
Broadhead, Garland C	Columbia, Missouri
Burgess, Edward S	New York, New York
Butler, J. D	Madison, Wisconsin
Byers, W. N	Denver, Colorado
Canby, William M	Wilmington, Delaware
Carr, Lucien	Cambridge, Massachusetts
Caton, J. D.	Ottawa, Illinois
Channon, Irving M.	Kusaie, Caroline Islands
Chapman, W. Albert	Smithville, Lawrence Co., Ark.
Claypole, Edward W	Akron, Ohio
Cleveland, Daniel	San Diego, California
Cockerell, Theodore D. A.	Boulder, Colorado
Comstock, J. Henry	Ithaca, New York
Comstock, Theodore B	Los Angeles, California
Condon, Thomas	Portland, Oregon
Cook, Albert J.	Claremont, California
Coulter, John Merle	Chicago, Illinois
Cowan, Frank	Greensburg, Pennsylvania
Cox, Lisbon A	Keokuk, Iowa
Crampton, Charles A	Washington, D. C.
Cresson, Ezra T	Philadelphia, Pennsylvania
Dall, William H	Washington, D. C.
Dodge, Charles Richards	Washington, D. C.
Edwards, William H	Coalburgh, West Virginia
Egan, W. C	Highland Park, Illinois
Eliot, T. L	Portland, Oregon
Emerton, James H	Boston, Massachusetts
Engelmann, George J	Framingham, Massachusetts
Farlow, William G	Cambridge, Massachusetts
Farnsworth, Philo J	Clinton, Iowa
Forbes, S. A	Urbana, Illinois
Gentry, Thomas G	Philadelphia, Pennsylvania
Gill, Theodore N	Washington, D. C.
Goodale, George L	Cambridge, Massachusetts
Greene, Edward L	Washington, D. C.
Haworth, Erasmus	Lawrence, Kansas
Hill, Ellsworth J	Chicago, Illinois
Hinrichs, Gustavus.	St. Louis, Missouri
Iles, Malvern W	Los Angeles, California
Ingersoll, Ernest	New York, New York
Jones, Joseph	
Kempker, John F	Davenport, Iowa
King, J. D	
Kock, Carl Ludwig	Nürnberg, Germany
Lefebure, E. Lucas	Cedar Rapids, Iowa
Lemmon, John Gill	Oakland, California
Leverett, Frank.	Ann Arbor, Michigan
Lindahl (Johan Harald) Josua	Cincinnati, Ohio
Lingle, David J	Chicago, Illinois
Lintner, J. A	Albany, N. Y.
McCook, Henry C	Devon, Pennsylvania
McGee, WJ	St. Louis, Missouri
McLean, J. P	Greenville, Ohio

McNeill, Jerome	Richmond, Indiana
Mann, B. Pickman	Washington, D. C.
Mark, Edward L.	Cambridge, Massachusetts
Mason, Otis T.	Washington, D. C.
Maxwell, S. A	Morrison, Illinois
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Morse, Edward S.	Salem, Massachusetts
Nipher, Francis E.	St. Louis, Missouri
Patterson, H. N	Oquawka, Illinois
Peckham, George W	Milwaukee, Wisconsin
Peet, Stephen D.	Chicago, Illinois
Philippi, R. A.	Santiago, Chili
Pigeon, Mrs. J. C. D.	Roxbury, Massachusetts
Ridgway, Robert.	Washington, D. C.
Sanchez, Jesus	Mexico, Mexico
Saunders, William	Ottawa, Canada
Saussure, Henri de	Geneva, Switzerland
Scudder, Samuel H.	Cambridge, Massachusetts
Shaw, James B	Decatur, Illinois
Shimek, Bohumil	Iowa City, Iowa
Simon, Eugene	Paris, France
Simpson, Charles T.	Lemon City, Florida
Smith, Harlan I	New York, New York
Smith, Sidney I.	New Haven, Connecticut
Snow, Francis H	Lawrence, Kansas
Stearns, Robert E. C	Los Angeles, California
Tandy, M.	Dallas City, Illinois
Thomas, Cyrus.	Washington, D. C.
Thorell, T. T. T.	Upsala, Sweden
Tracy, Samuel M.	Biloxi, Mississippi
Trimen, Roland.	England
Uhler, Philip R	Baltimore, Maryland
Ulke, Henry	Washington, D. C.
Velie, J. W..	St. Joseph, Michigan
Verrill, Addison E	New Haven, Connecticut
Villada, Manuel.	Mexico, Mexico
Vining, Edward P.	San Francisco, California
Ward, Henry A	Rochester, New York
Webster, Charles.	Charles City, Iowa
White, A. D	Ithaca, New York
Whitfield, Robert P	New York, New York
Wickham, Henry F.	Iowa City, Iowa
Wilder, Burt G.	Ithaca, New York
Winchell, Newton H	Minneapolis, Minnesota
Witter, F. M.	Muscatine, Iowa
Zawodny, Joseph.	Prague, Austria

LIFE MEMBERS.

(Residence Davenport, unless otherwise stated.)

Adams, Mrs. Mary P.
Andresen, Richard
Balch, Frank A.
Ballord, Miss Elizabeth W.
Ballord, Webb
Beenck, J. C.
Berger, Edward
Best, Louis P.
Burdick, Anthony
Cable, George W.
Cable, George W., Jr.
Crossett, Edward S.
Crossett, Edward C.
Cutter, Amos F.
Davis, Frank O.
Davison, Miss Ella
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Elmer, Albert W.
Ficke, Charles August
Ficke, Mrs. Charles August
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Ficke, Arthur D.
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French, Nathaniel
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McClelland, Wilson
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Putnam, H. St. Clair, New York
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Richardson, Jenness J.
Richardson, Mrs. Emma A.
Roberts, Edward C.
Roberts, Mrs. Julia A.
Robinson, Mrs. J. F., Rock Island, Ill.
Roddewig, Paulo
Rothschild, Isaac
Sheldon, Miss S. G. F.
Torry, Mrs. Henry, Cambridge, Mass.
Vollmer, Henry
Whitaker, Mrs. Lottie H.

REGULAR MEMBERS.

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Banning, George W.
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Block, Louis
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Brockmann, John
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Brugman, John J.
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Burch, Ira C.
Burrows, Parke T.
Burrows, Mrs. Parke T.
Bush, Arthur G.
Bushnell, Horace T.
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Ditzen, Julius
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Nagy, Bela A.
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Nutting, Mrs. James R.
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Ostrom, Lewis, Rock Island, Ill.
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Peck, Mrs. Maria Purdy
Peck, Raymond E.
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Preston, Charles I.
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Renwick, Miss Rebecca
Richardson, Maurice N.
Richter, August
Riepe, Adelbert
Roberts, Horace G.
Robeson, Charles E.
Rothschild, Moses
Rothschild, Mrs. Moses
Rudolf, F. Eugene
Ryan, Edgar H.
Schaefer, John H.
Schmidt, William O.
Schroeder, Henry
Sears, Isaac H.
Sheaff, Mrs. Isabella
Sherier, Julius M.
Sieg, Mrs. Victoria
Silberstein, Emil
Silberstein, Louis
Silberstein, Martin
Silberstein, Mrs. Martin
Silberstein, Max
Smart, Frank L.
Smith, John James
Smith, Mrs. J. J.
Snider, William H.
Stibolt, Victor A.
Stolle, William J.
Suksdorf, Carl L.
Temple, Seth J.
Thatcher, J. L.
Thomas, Miss Emma
Tillinghast, Benjamin F.
Udden, John A., Rock Island, Ill.
Udden, John A., Jr., Rock Island, Ill.
Vander Veer, A. W.
Van Patten, J. P.
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Vollmer, Arthur
Vollmer, Karl
Von Maur, Charles J.
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Voss, Charles N.
Wadsworth, Mrs. W. C.
Waldman, George L.
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Waterman, Mrs. Charles M.
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Watzek, Mrs. John W.
Wells, William D.
Whitaker, Byron
Whitaker, Miss Edna
Whitaker, John H.
White, Edmund M.
White, I. S., Rock Island, Ill.
Williams, Howard L.
Wiswell, Mrs. F. J.
Yaggy, Louis J.

ARTICLES OF INCORPORATION

OF THE

DAVENPORT ACADEMY OF SCIENCES.

As amended December 28, 1906.

Article I.—Name and Object.

Section 1.—This Society shall be known as The Davenport Academy of Sciences and shall have for its objects the increase and diffusion of a knowledge of, and the encouragement of an interest in the arts and sciences, by the establishment of a museum, art gallery, and library, by the reading and publication of original papers, and by other suitable means.

Article II.—Members.

Section 1.—This Society shall consist of regular, honorary, and corresponding members, who shall be elected in such manner as the by-laws may prescribe.

Section 2.—The right of voting and holding office shall be confined to regular members, but honorary and corresponding members shall be entitled to all other privileges.

Article III.—Officers and Trustees.

Section 1.—The officers of the Academy shall consist of a President, Vice-President, Secretary, and Treasurer.

Section 2. The President, Secretary, and Treasurer, with nine (9) other members, shall form a Board of Trustees for the management of the business of the Academy, and to conduct its proceedings, and a majority of such members shall constitute a quorum for the transaction of business.

Section 3.—The officers, and three members of the Board of Trustees to serve three years, shall be elected at the annual meeting on the second Tuesday of January in each year, and must receive a majority of the votes cast. In case of a vacancy, caused by the death or resignation of any officer or trustee, the Trustees shall fill the same.

Article IV.—Acquisition and Management of Property.

Section 1.—The Academy may receive, hold, and manage all property acquired by gift or purchase necessary or proper to promote its objects.

Section 2.—The Board of Trustees shall be empowered to purchase real estate and to make such improvements thereon as it deems necessary or proper to promote the objects of the Academy, but no such property of the Society shall be sold except in accordance with an affirmative vote of a majority of the Board of Trustees, ratified by a majority of the members of the Society present at a special or business meeting held after due notice given, specifying the objects thereof.

Article V.—By-Laws.

Section 1.—The Board of Trustees shall have the power to make all needful by-laws, rules, and regulations for the purpose of carying out the objects of the Society and conducting its affairs, and not inconsistent with the Articles of Incorporation.

Article VI.—Amendments.

Section 1.—The provisions of the Articles of Incorporation may be amended by a two-thirds vote of those present at any regular meeting of the Trustees, provided that the same shall be ratified by a vote of two-thirds of the members present at any regular meeting of the Academy or at a special meeting called for such purpose, notice of such special meeting to be published in some newspaper in the city of Davenport at least one week prior to the time of holding same.

BY-LAWS

OF THE

DAVENPORT ACADEMY OF SCIENCES.

Amended February 5, 1907.

Article I.—MEMBERS.

Section 1.—Regular members shall be elected as follows: The name of any person who is recommended in writing by two regular members shall be posted in the Academy building for at least one week and then voted upon by the Executive Committee, a two-thirds vote being necessary for election.

The annual dues of the Regular Members shall be three ($3.00) dollars payable on the first day of January, in advance, except that for members elected after March a deduction of seventy-five (75) cents shall be made for each fully completed quarter.

Any Regular Member may become a Life Member by paying fifty ($50) dollars to the Treasurer and notifying the Secretary, thereby becoming exempt from further dues.

Section 2.—Any person not residing in Davenport may become a Corresponding Member of the Academy in the same manner as that prescribed for Regular Members. Corresponding Members shall have the privileges of Regular Membership except those of voting and holding office, but shall be exempt from dues. Any Corresponding Member may become a Regular Member by notifying the Secretary and paying his dues.

Section 3.—Any person eminent for his attainments in science may be elected an Honorary Member at the annual meeting only of the Academy upon nomination by the Board of Trustees, and shall have the privileges of Regular Membership except those of voting and holding office, but shall be exempt from dues. The number of Honorary members shall not exceed twenty-five.

Article II.—DUTIES OF OFFICERS.

Section 1. The President, or in his absence or inability to serve, the Vice-President, shall preside over the meetings of the Academy and of the Board of Trustees, and shall perform such duties as usually appertain to his office.

Section 2.—The Secretary shall keep a record of meetings, shall notify members and officers of election, and shall perform such duties as ordinarily appertain to his office both for the Academy and for the Board of Trustees.

Section 3.—The Treasurer shall receive and disburse all moneys of the Academy under the direction of the Board of Trustees, shall make a written annual report, shall give such bonds as the Board of Trustees shall require, and in general shall perform such duties as ordinarily appertain to his office.

Section 4.—The Board of Trustees shall transact the business of the Academy, shall have control of all expenditures of money, shall engage such officials as are hereinafter provided for or as may be needed for the welfare of the Academy, shall make rules for the Museum and Library, and shall have full power to act for the interests of the Academy in any way not inconsistent with the Constitution and By-Laws.

Section 5.—Any vacancy caused by the death or resignation of any officer or trustee shall be filled by the Board of Trustees, but a Trustee so elected shall hold office only until a successor is chosen at the next annual meeting of the Academy.

Article III.—STAFF.

Section 1.—The Board of Trustees shall appoint a Director, a Curator, a Librarian, an Editor, and such other officials and assistants as may be needed for the welfare of the Academy, and shall fix the term and compensation for all such appointments.

Section 2.—The Director, subject to the Board of Trustees, shall be entrusted with the general executive direction of the scientific and other activities of the Academy.

Section 3.—The Curator shall have general charge of the Museum.

Section 4.—The Librarian shall have general charge of the Library.

Section 5.—The Editor shall have general charge of the publications of the Academy.

Article IV.—COMMITTEES.

Section 1.—The Standing Committees shall consist of an Executive Committee, Finance Committee, Advisory Committee, Museum Committee, Library Committee, Historical Committee, Art Committee, Publication Committee, and Lecture Committee.

The President shall appoint all the Standing Committees, except as hereinafter provided, at the annual meeting or as soon thereafter as practicable.

Section 2.—The Executive Committee shall consist of five members, the President, the Vice-President, the Secretary, and the Treasurer, *ex-officio*, and one Trustee to be appointed by the President. The Committee, under the direction of the Board of Trustees, shall act in all matters of routine and shall elect the members of the Academy as hereinbefore provided.

Section 3.—The Finance Committee shall consist of three members and consider all matter concerning the financial interests of the Academy. The Treasurer shall be an *ex-officio* member of this committee.

Section 4.—The Advisory Committee shall consist of the President, the Director, the Curator, the Librarian, the Editor, and of the Chairman of the Museum, Library, Historical, Art, Publication and Lecture Committees.

It shall be the business of this Committee to consider such matters dealing with the scientific and other activities of the Academy as are referred to it by the Board of Trustees, and to present to the Trustees recommendations for the welfare of the Academy.

Section 5.—The Museum Committee shall consist of three members and shall consider all matters that have to do with the welfare of the Museum. The Director and Curator shall be consulting members of this committee, *ex-officio*.

Section 6.—The Library Committee shall consist of three members and shall consider all matters that have to do with the welfare of the Library. The Director and Librarian shall be consulting members of this committee, *ex-officio*.

Section 7.—The Historical Committee shall consist of three members and shall consider all questions that have to do with historical matters. The Director shall be a consulting member of this committee, *ex-officio*.

Section 8.—The Art Committee shall consist of three members and shall consider all matters that have to do with the welfare of the Gallery. The Director shall be a member of this committee, *ex-officio*.

Section 9.—The Publication Committee shall consist of five members and shall direct the publications of the Academy. The Director and the Editor shall be members of the Publication Committee, *ex-officio*.

Section 10.—The Lecture Committee shall arrange for lectures and public meetings of the Academy. The Director shall be an *ex-officio* member of this committee.

Article V.—MEETINGS.

Section 1.—The regular annual meeting of the Academy shall be held on the second Tuesday in January, at which time the order of business shall be as follows:

1. Reading of minutes of last annual meeting.
2. Annual reports of officers and committees.
3. The President's address.
4. Election of officers.
5. Other business.
6. Adjournment.

Section 2.—Regular meetings of the Academy for the reading of papers and discussion shall be held on the last Friday of each month.

Section 3.—Regular meetings of the Board of Trustees shall be held on the second Friday of each month at which the order of business shall be:

1. Reading of minutes.
2. Reports of officers and committees.
3. Deferred business.
4. New business.
5. Adjournment.

Section 4. Special meetings of the Academy may be called at any time by the President or the Board of Trustees, or upon written request of five members. Special meetings of the Board of Trustees may be called at any time by the President, or upon the written request of three Trustees.

Section 5.—Ten members shall constitute a quorum at any meeting of the Academy, and four Trustees at any meeting of the Board of Trustees.

Section 6.—Where not in conflict with the Constitution and By-Laws, the Academy shall be governed by Robert's Rules of Order.

Article VI.—Sections.

Section 1.—Sections of the Academy holding separate meetings may be formed upon the written application of five members, by consent of the Trustees.

Section 2.—Membership in the Sections shall be open only to members of the Academy.

Section 3.—All collections, books, and permanent funds of the Sections shall be the property of the Trustees of the Academy.

Section 4.—Sections shall make an annual report to the Academy.

Section 5.—Sections shall have the right to make additional regulations for perfecting the organization, subject to the approval of the Trustees.

Article VII.—Publications.

Section 1.—Under the direction of the Editor, subject to the approval of the Publication Committee, the Academy shall publish a series to be known as the "Proceedings of the Davenport Academy of Sciences" and such other publications as may seem to promote the objects of the Academy.

Section 2.—The Academy shall exchange its publications with those of other societies, universities, libraries, and journals.

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CORRECTIONS.

Page 4, 3d line from bottom, add (Plate 13).

"	37.	For Acer nigra	read	Acer nigrum.
"	37.	" Acer saccharninum	"	Acer saccharinum.
"	41.	" Ulnus fulva	"	Ulmus fulva.
"	63.	" Hordem jubatum	"	Hordeum jubatum.
"	63.	" Scripus palustris	"	Scirpus palustris.
"	63.	" Polygonum muhlenbergi	"	Polygonum muhlenbergii.
"	63.	" Rumex martimus	"	Rumex maritimus.
"	63.	" Distichlis apicata	"	Distichlis spicata.
"	64.	" Habenaria psychodes	"	Habenaria psycodes.
"	65.	" Dodecatheon media	"	Dodecatheon meadia.
"	65.	" Maiantherum canadense	"	Maianthemum canadense.
"	65.	" Viola blanca	"	Viola blanda.
"	65.	" Cypriepedium pubescens	"	Cypripedium pubescens.
"	68.	" B. venenosur liquefaciens	"	B. venenosus liquefaciens.
"	69.	" Quercus ruba	"	Quercus rubra.
"	69.	" Triosetum perfoliatum	"	Triosteum perfoliatum.
"	70.	" Arabii lyrata	"	Arabis lyrata.
"	70.	" Acer rubra	"	Acer rubrum.
"	70.	" Pyrus iowensis	"	Pyrus ioensis.
"	70.	" Dodecatheon media	"	Dodecatheon meadia.
"	71.	" Diervillea trifida	"	Diervilla trifida.
"	71.	" Coptri trifolia	"	Coptis trifolia.
"	71.	" Pyrus iowensis	"	Pyrus ioensis.
"	71.	" Quercus macrcarpa	"	Quercus macrocarpa.
"	72.	" Poa pratense	"	Poa pratensis.
"	72.	" Populus monolifera	"	Populus monilifera.
"	72.	" Dulichtrium spatuaceum	"	Dulichium spathaceum.
"	72.	" Poa scratina	"	Poa serotina.
"	72.	" Pinus stroba	"	Pinus strobus.
"	72.	" Texus canadensis	"	Taxus canadensis.
"	73.	" Phegoteris	"	Phegopteris.
"	73.	" Phegoteris polypodioides	"	Phegopteris polypodioides.
"	74.	" Dodecatheon media	"	Dodecatheon meadia.
"	78.	" Lysimachia thrysiflora	"	Lysimachia thyrsiflora.
"	78.	" Menyanthes trifolia	"	Menyanthes trifoliata.
"	79.	" Eriophorus virginicum	"	Eriophorum virginicum.
"	79.	" Cnicus miticus	"	Cnicus muticus.
"	79.	" Parnassia carolinians	"	Parnassia caroliniana.
"	81.	" Glyceria arundinaceæ	"	Glyceria arundinacea.
"	82.	" Viola carina	"	Viola canina.
"	83.	" Ilysanthus riparia	"	Ilysanthes riparia.
"	83.	" Nymphea tuberosa	"	Nymphæa tuberosa.
"	84.	" Phyragmites communis	"	Phragmites communis.
"	84.	" Burnus kalmii	"	Bromus kalmii.
"	85.	" Elocharis	"	Eleocharis.
"	87.	" Menyanthes trifolia	"	Menyanthes trifoliata.
"	88.	" Populous tremiloides	"	Populus tremuloides.
"	89.	" Castilleia sessilifolia	"	Castilleia sessiliflora.
"	91.	" Poa nemoralis	"	Poa memoralis.
"	93.	" Lithospermum angustifolius	"	Lithospermum angustifolium.
"	93.	" Castilleia sessilifolia	"	Castilleia sessiliflora.
"	96.	" Pyrus iowensis	"	Pyrus ioensis.
"	98.	" Dierville trifida	"	Diervilla trifida
"	99.	" Heliathemum canadense	"	Helianthemum canadense.
"	100.	" Pruuus virginiana	"	Prunus virginiana.
"	101.	" Fraximus viridis	"	Fraxinus viridis.
"	101	" Pyrus iowensis	"	Pyrus ioensis.
"	102.	" Cnicus mutians	"	Cnicus muticus.
"	104.	" Menythayhes trifoliata	"	Menyanthes trifoliata.
"	105.	" Camptosorus rbeizophyllus	"	Camptosorus rhizophyllus.
"	110.	" Scripus lacustris	"	Scirpus lacustris.
"	110.	" Populus monolifera	"	Populus monilifera.
"	111.	" Asarum canadensis	"	Asarum canadense.
"	112.	" Calamagrostic canadensis	"	Calamagrostis canadensis.
"	112.	" Dodecatheon media	"	Dodecatheon meadia.
"	113.	" Dodecatheon media	"	Dodecatheon meadia.
"	116.	" Arenaria latifolia	"	Arenaria laterifolia.
"	116.	" Spirea aruncus	"	Spiræa aruncus.
"	116.	" Panicium autumnale	"	Panicum autumnale.

Following page 162. The unnumbered plate is Plate X.

Page 205, line 16 from bottom. For 1907, read 1906.

Explanation of Plate IX, figure 2, Fossil Plant Remains. For toredo, read teredo.

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